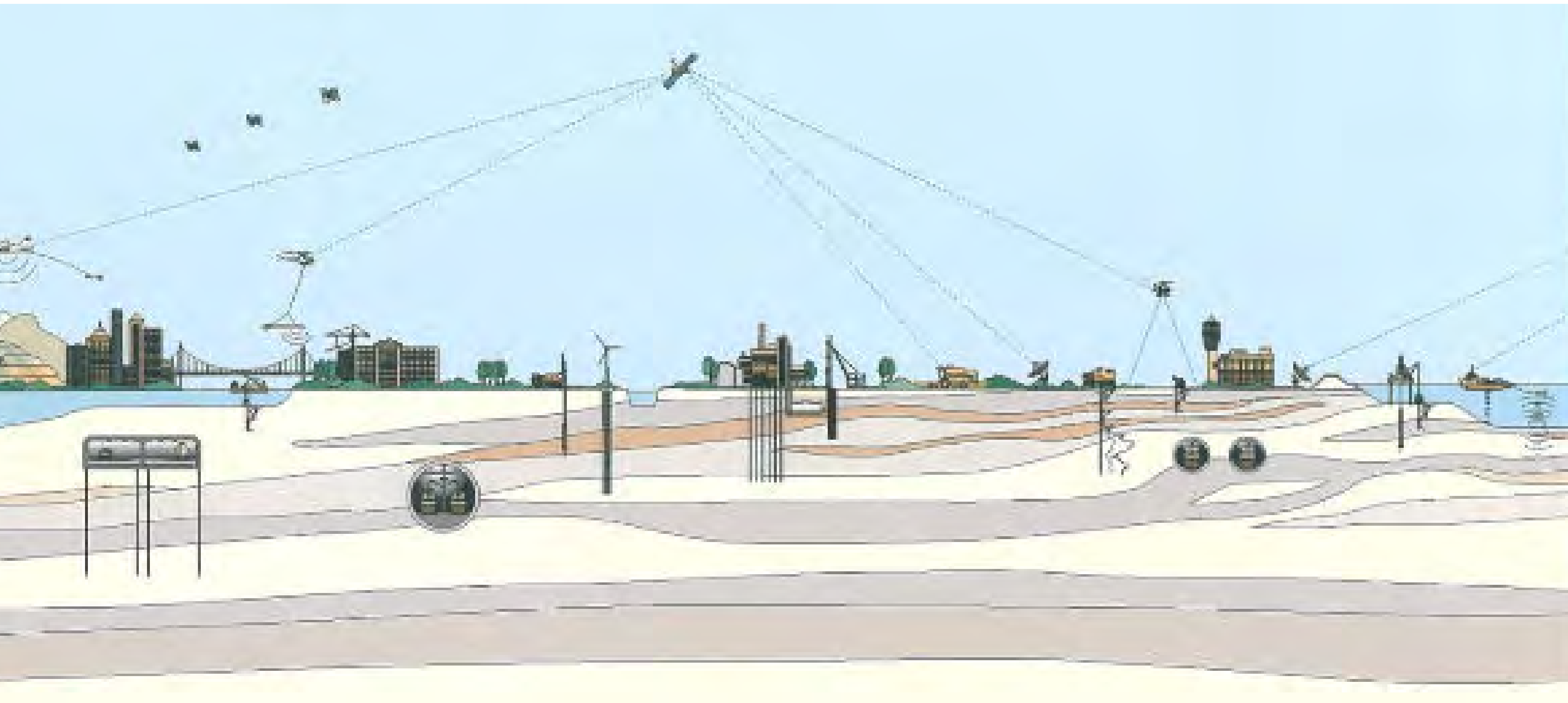
FUGRO WEST, INC.

DRAFT GEOTECHNICAL INVESTIGATION FOR DEPARTMENT OF CORRECTIONS AND REHABILITATION MENTAL HEALTH CRISIS BEDS CALIFORNIA MEN'S COLONY SAN LUIS OBISPO, CALIFORNIA

Prepared for:
Nacht & Lewis Architects

August 2009
Fugro Project No. 1766.005



FUGRO WEST, INC.

1009 Enterprise Way, Suite 350
Roseville, California 95678
Tel: (916) 773-2600
Fax: (916) 782-4846

August 10, 2009
Project No. 1766.005

Mr. Salah Ahmed
Nacht & Lewis Architects
600 Q Street, Suite 100
Sacramento, CA 95814

Subject: **Draft Geotechnical Investigation Report for the Mental Health Crisis Beds, California Men's Colony Project, San Luis Obispo, California.**

Dear Mr. Ahmed:

Enclosed is our Geotechnical Investigation Report for the above proposed development at the California Men's Colony (CMC), which is located approximately 3 miles northwest of the City of San Luis Obispo along the Cabrillo Highway in San Luis Obispo County, California. The work was performed in accordance with our proposal, dated August 29, 2008.

Our geotechnical investigation was performed to evaluate the subsurface conditions at the subject site, as well as provide recommendations for design and construction. Provided our recommendations are followed, it is our opinion that the conditions at the project site are suitable for conventional foundation and pavement construction using standard equipment and techniques. There is a potential for the need of heavy-duty equipment when excavating in areas of shallow Franciscan Formation located in the topographic high areas in the southeastern region of the project site.

Geotechnical investigations using a limited number of exploratory borings rely on an assumption of uniformity of soil between probes. Often during construction we find this not to be the case; therefore, in presenting this report we do so with the understanding that we will be allowed to continue on this project by providing inspection and testing services during construction.

Sincerely,

FUGRO WEST INC.

Original signed	*Original signed*
Matt O'Banion	Michael Hughes, P.E.
Staff Geologist	Branch Manager

1766.005 Draft GIR_Rev2

CONTENTS

PLATES

APPENDICES

1.0 INTRODUCTION

1.1 LOCATION AND DESCRIPTION OF PROJECT

This geotechnical report presents the results of the design level geotechnical investigation conducted by Fugro West, Inc. (Fugro) for the California Men's Colony (CMC) 50-Mental Health Crisis Beds (MHCB) project, located at the southwest corner of the existing CMC facility. The project site is located approximately 3 miles northwest of the City of San Luis Obispo along the Cabrillo Highway in San Luis Obispo County, California, as shown on the Vicinity Map- Plate 1.

We understand the proposed improvements will consist of an approximately 45,000 square feet of lightly loaded, stand alone single-story structure (MHCB) and a separate Armory building. Infrastructure improvements will include addition of new parking areas, four guard towers and the expansion of the electric fence system.

Anticipated details of building construction include exterior walls of bearing concrete masonry with concrete spread footings at columns and continuous footings at exterior and interior bearing walls with a concrete slab floor. Interior walls are typically of masonry construction and the roof system is normally single-ply roofing over metal deck supported by steel beams.

1.2 PURPOSE AND SCOPE

The purpose of the geotechnical investigation was to provide the project team with the necessary geotechnical design parameters for construction of the proposed MHCB structure, guard towers, parking areas, electrical fence and Armory building. The scope of our services performed included the following tasks.

1. Reviewed previous relevant studies completed in the project vicinity and published documents pertaining to site geology and soil conditions,

2. Notified Underground Service Alert (USA) and private utility locators to identify the location of underground utilities prior to the field investigation,

3. Completed drilling and soil sampling at the site by drilling nineteen (19) exploratory borings to depths of approximately 5 to 30 feet below ground surface (bgs). The borings were sampled at regular intervals and used to define the soil and groundwater conditions and to obtain soil samples for laboratory testing. A technical specialist from Fugro logged all borings. The boring logs are presented in Appendix A,

4. Performed seven (7) refraction microtremor (ReMi) surveys and four (4) seismic refraction surveys to provide data regarding the undulating bedrock profile beneath the

proposed MHCB facility. The average shear wave velocity gathered from the ReMi data was used to determine the California Building Code (CBC) site class for the proposed project site,

5. Completed two (2) in-situ resistivity surveys in the area of the proposed MHCB facility to provide information to determine corrosion potential of the on site soils,

6. Performed laboratory tests on selected bulk and undisturbed soil samples to determine basic soil properties. Testing consisted of moisture/density determination, Atterberg limits, sieve analysis, corrosivity, expansion index, unconfined compressive strength, compaction and an R-value testing, the lab testing results are presented in Appendix B, and,

7. Prepared this geotechnical investigation report presenting the following:

   a) Summaries of soil descriptions, consistency, engineering properties, and discussions of groundwater conditions,

   b) Recommended values for foundation design: allowable bearing capacities, predicted total and differential settlements and lateral earth pressures,

   c) Recommended seismic design parameters based on 2007 CBC criteria,

   d) Recommendations for interior slab-on-grade and exterior flatwork,

   e) Recommendations for general site grading, earthwork, and trench backfill, and

   f) Considerations for special features such as resistance design for pole foundations, drilled piers and soil shrinkage/swell potential for earthwork operations.

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices in the Northern California area. This warranty is in lieu of all other warranties, either expressed or implied.

1.3 PREVIOUS STUDIES

Previous geotechnical studies have been undertaken at the CMC site. In particular, a geotechnical report was prepared in 2005 by Fugro entitled Geotechnical Report, California Men's Colony Water System Upgrade, San Luis Obispo, California (Fugro, 2005). The report includes investigation results for two extensive sites, one west of State Route 1 (SR1) and one east of SR1. The western site includes the CMC Wastewater Treatment Plant and California Army National Guard's Camp San Luis Obispo and the eastern site includes the CMC facility.

The current project location borders the eastern extent of the site east of SR1. The field investigation included the advancement of thirty-seven (37) exploratory borings in addition to the review of thirty-four (34) additional borings completed as part of a Fugro investigation in 2000. A review of the information indicated that the current project area is located in close proximity to Borings B-1, B-3 and DH-26, which were advanced to depths of between 15 and 24 feet bgs. Laboratory testing included in-place moisture content, dry-unit weight, corrosivity and compressive strength testing.

A report was prepared in 1998 by Ninyo & Moore entitled Geotechnical Report California Men's Colony (East) San Luis Obispo, California (Ninyo, 1998). The report provides recommendations for the design and construction of proposed fence improvements surrounding the eastern CMC facility. The field investigation included the advancement of six (6) exploratory borings. A review of the information indicated that the current project area is located in close proximity to Borings B-1, B-2 and B-5 advanced to depths of between 7 and 11.5 feet bgs. Laboratory testing included in-place moisture content, dry unit weight, corrosivity and Atterberg Limit testing.

A review of soil conditions identified by these previous investigations indicated similar soil conditions to those encountered as part of the current investigation, with varying thicknesses of artificial fill and alluvial soils consisting of clayey sands and clays, with varying amounts of gravel, overlying Franciscan Formation bedrock.

Relevant field exploration logs and laboratory test results can be found in Appendix C and D, respectively.

2.0 GEOLOGIC SETTING

2.1 REGIONAL GEOLOGY

The project site is located within the Coast Ranges Geomorphic Province of California. This province is a north-northwest-trending mountain belt extending from approximately Santa Maria toward the north into Humboldt County, with a small portion extending to the California-Oregon border (Hinds, 1952). The Coast Ranges are composed of Mesozoic-age to recent sedimentary, volcanic, metamorphic, and granitic rocks.

The project area is located within the Santa Lucia Range of the southern Coast Ranges. The Santa Lucia Range is composed of Mesozoic-age to recent sedimentary, volcanic, metamorphic, and igneous rocks. Folds and faults within the Santa Lucia Range are generally oriented northwesterly, which diverges slightly from the north-northwest structure of the Coast Ranges (Norris and Webb, 1990).

2.2 LOCAL GEOLOGY

Published geologic literature indicates the majority of the project site is underlain by Quaternary (less than 1.6 million years old) alluvial materials associated with the formation of the Chorro Creek valley and its tributaries, underlain by bedrock of the Franciscan Formation (KJf) (Hall, Ernst, Prior, and Wiese, 1975). The hillsides and upland areas surrounding the site comprise Franciscan Formation with little to no overlying alluvium. Refer to Plate 2 for a Regional Geologic Map.

2.3 REGIONAL SEISMICITY

The computer program EQFAULT v3.0 (Blake, 2000) was used to search a 100-mile radius around the project site to locate seismic sources that will have the highest potential for ground shaking at the project location. A total of forty (40) potentially active faults/fault zones were identified, of these, six are located within 30-miles of the project site and are summarized in Table 1. The seismic sources expected to have the greatest impact due to their proximity are the Los Osos and San Luis Range fault zones located approximately 3.5 and 4.5 miles away, respectively. The Los Osos fault zone trends northwest/southeast and is approximately 30 miles in length. The eastern part of the Los Osos fault zone is often referred to as part of the Edna fault zone and the western end is thought to extend offshore, where it intersects with the Hosgri fault zone. According to the Southern California Earthquake Data Center, the Los Osos fault zone was last active in Late Quaternary times except for a 5km segment near San Luis Obispo, which was active in more recent Holocene times. A Regional Fault Location Map is presented as Plate 3.

Table 1. Potential Seismic Sources Within a 30-mile Radius of the Project Site

Seismic Source	Approximate Distance (miles)	Maximum Earthquake Magnitude
Los Osos	3.5	7.0
San Luis Range (S. Margin)	4.5	7.2
Rinconada	8.7	7.5
Hosgri	14.7	7.5
Casmalia (Orcutt frontal Fault)	27.1	6.5
San Juan	29.0	7.1

2.3.1 Historical Seismicity

We performed a computerized search of historical earthquakes and estimated ground accelerations that could have impacted the CMC facility using the computer program EQSEARCH (Blake, 2000). The program searches the California Geological Survey (CGS) earthquake catalog and estimates the ground accelerations based on attenuation relationships and onsite material characteristics. A review of the output indicates that the project site may have experienced ground accelerations of up to approximately 0.290g (where g is equal to earth's gravity) during a historic magnitude 5.9 event on 12/07/1906 approximately 1.6-miles away.

3.0 SITE CONDITIONS

3.1 TERRAIN

The general topography of the site is relatively flat in the Chorro Creek alluvial valley surrounded by rolling to relatively steep bedrock hills in the upland areas. The majority of the proposed improvements including, the MHCB facility, parking areas, electrical fence, Armory and two of the four guard towers are located within an area of flat to gently sloping ground. The remaining two guard towers are to be located within the area of higher ground in the southeastern portion of the site.

3.2 FIELD EXPLORATION AND SUBSURFACE SOIL CONDITIONS

Our fieldwork was conducted between June 22nd and 25th, 2009, and comprised nineteen (19) geotechnical borings (referenced B-1 through B-19) advanced to depths of between 5 and 30 feet bgs, two (2) in-situ resistivity surveys and seven (7) ReMi seismic surveys, four of which doubled as seismic refraction surveys. A CMC Layout Plan and Boring/Survey Location Maps are provided as Plate 4 and Plates 5a-b, respectively. The boring logs are presented in Appendix A and the results of the ReMi/seismic refraction surveys are presented in Appendix E.

The subsurface materials encountered throughout the project site consisted of varying thicknesses of artificial fill and alluvium overlying bedrock of the Franciscan Formation. Typically, the thickness of the overlying soil increased in a northwesterly direction from approximately 6 to 26 feet. In the area of high ground to the southeast, subsurface materials consisted of decomposed to intensely weathered Franciscan Formation transitioning to competent Franciscan bedrock at a depth of 4 to 10 feet bgs.

General descriptions of the different types of materials encountered during the investigation are presented below. If the soil conditions at a specific location are desired, the reader is advised to consult the logs of borings in Appendix A. On the boring logs, the soil type, color, moisture, consistency, and Unified Soil Classification (USC system) symbols are indicated.

3.2.1 Artificial Fill

Artificial fill materials were encountered at many of the boring locations explored. The fill materials ranged in thickness from approximately 3 to 12 feet and typically consisted of loose to very dense clayey sand and soft to very stiff clays with varying amounts of gravel. Asphalt concrete paving material was encountered at several locations as noted on the boring logs.

Field N-values recorded in the artificial fill materials throughout the project site ranged from 4 to 47 blows per foot (bpf) with an average of 19 bpf. Laboratory test results indicate that the dry density and moisture content ranged from 102 to 128 pounds per cubic foot (pcf) and 7 to 24%, respectively. Maximum dry density and optimum moisture content of the artificial fill materials ranged from 127 to 130 pcf and 10 or 11%, respectively.

The measured fines content for selected samples ranged from 12 to 79% with an average of 35%. The results of Atterberg limits testing had Liquid Limits ranging from 33 to 54 and Plasticity Indexes ranging from 18 to 40, indicating that the fine grained material is predominantly medium to high plasticity clay.

Undrained shear strengths of artificial fill materials estimated from field pocket penetrometer field data ranged from 2.0 to 8.5 ksf.

3.2.2 Alluvium

The alluvial sediments encountered in our borings ranged in thickness from approximately 0 to 26 feet and typically consisted of stiff to hard clays with varying amounts of sand/gravel and occasional medium dense to very dense clayey sands and gravel.

Field N-values recorded in the alluvial sediments throughout the project site ranged from 9 to 40 bpf with an average of 19 bpf. An unconfined compression test resulted in a strength of approximately 5,100 psf. Laboratory test results indicate that the dry density and moisture content ranged from 100 to 139 pcf and 6 to 24%, respectively. Compaction testing indicated a maximum dry density of 122 pcf and optimum moisture content of 13.5%.

The measured fines content for selected samples ranged from 11 to 33% with an average of 22%. The results of Atterberg limits testing had Liquid Limits ranging from 39 to 43 and Plasticity Indexes ranging from 25 to 32, indicating that the fine grained material is predominantly medium to high plasticity clay.

Undrained shear strengths of alluvial soils estimated from field pocket penetrometer field data ranged from approximately 2.5 to over 9 ksf.

3.2.3 Franciscan Formation

Franciscan Formation bedrock was encountered in 17 of the 19 exploratory borings. As indicated on the boring logs, Franciscan Formation materials was encountered within approximately 0.5 feet of the surface in the topographic high area in the southeastern portion of the project site and as deep as 26 feet in the northeastern portion of the site. Depth to bedrock within the proposed parking area and Armory site were found to be approximately 5 and 10 feet bgs, respectively. The bedrock materials encountered consisted of intensely to moderately weathered, very intensely to intensely fractured claystone and decomposed to intensely weathered claystone in the form of clays and gravel. Practical refusal to drilling was encountered at 2 locations at depths of 10 and 20 feet bgs.

Field N-values recorded within the Franciscan Formation bedrock encountered throughout the site ranged from 29 to greater than 100 bpf, with a majority being greater than 100 bpf. Samples of Franciscan Formation materials tested in the laboratory had dry densities and moisture content ranging from 115 to 133 pcf and 9.0 to 15.5%, respectively. Unconfined compression testing on decomposed to intensely weathered material resulted in strengths ranging from 7,500 to 12,700 psf.

The locations of our exploratory borings were determined by the topographic survey provided by Nacht & Lewis Architects. The accuracy of the information can only be implied to the degree that these methods warrant.

3.3 GROUNDWATER

Groundwater was encountered within the project site at various locations explored for this study as summarized in Table 2. The groundwater depths reported do not necessarily indicate seasonal perched or static groundwater levels, which may vary. The hydrostatic groundwater level can fluctuate with variations in precipitation, irrigation, groundwater withdrawal or injection, and other factors. Temporary perched groundwater conditions could also occur at the site during or closely following the rainy season.

Table 2. Summary of Groundwater Depths

Boring Number	Depth to Groundwater (Feet)	Date Recorded
B-1	16	6/23/2009
B-2	15	6/22/2009
B-3	14.5	6/22/2009
B-5	14	6/23/2009
B-6	13	6/23/2009
B-11	24	6/22/2009

3.4 LABORATORY TEST RESULTS

Selected samples obtained during fieldwork were tested to determine the physical and chemical properties of the soils. Testing consisted of moisture/density determination, Atterberg limits, sieve analysis, corrosivity testing, expansion index, unconfined compressive strength, compaction and R-value testing. The testing results and procedures used are discussed in Appendix B.

4.0 CONCLUSIONS

4.1 LEVELS OF SHAKING AND SEISMIC DESIGN

Based on our research, the Los Osos and San Luis Range fault zones are expected to have the greatest impact on the project site due to its proximity (approximately 3.5 and 4.5 miles, respectively). The site does not lie within or adjacent to an Alquist-Priolo Earthquake Fault Zone (Hart and Brayant, 1997) and no known Late Quaternary faults pass near the site or trend directly toward the site. The potential for ground rupture is considered to be low, unless some unknown faults were to rupture.

4.1.1 Deterministic Analysis

A deterministic analysis was performed using the computer program EQFAULT v3.0 (Blake, 2000) that provided information on known faults within a 100-mile radius from the site, which are thought to have the highest potential for ground shaking at the project location. This program computes fault distance using the new CGS fault database (CGS, 2002). The site is located at approximately latitude 35.3233º north, longitude –120.6938º west. In our analysis we used the attenuation equations of Boore et al (1997) and assumed an average shear-wave velocity of 550 meters per second (1800 feet per second) in the upper 30 meters (100 feet) based on Vs30 (Vs100) values calculated from the ReMi data. A shear-wave velocity of 550 meters per second corresponds to a Type "C" CBC Site Class designation.

The peak ground acceleration (PGA) for the maximum event (moment magnitude of 7.2) on the San Luis Range (S. Margin) Fault is estimated at approximately 0.424g.

4.1.2 Probabilistic Analysis

We performed a probabilistic analysis utilizing the computer program FRISKSP v.4.0, (Blake, 2000). The program was set to a search radius of 100-km (63-miles). The program database includes faults and fault segments, background sources, maximum moment magnitudes and fault slip rates. The selected database represents the seismotectonic model produced by California Geological Survey (CGS, 2002). The equations used for estimating ground motion were by Boore, et al (1997) with 5 percent damping. We also assumed an average shear-wave velocity of 550 meters per second in the upper 100 feet of the site as input to the attenuation equations.

Probabilistic methods were used to estimate the seismic ground-motion hazard at the project site. A peak ground acceleration (PGA) of 0.230g was determined for a design basis earthquake (DBE) event with a 10 percent chance of exceedence in 50 years, which corresponds to a recurrence frequency of 475 years. A PGA of 0.300g was determined for an upper-bound event (UBE) with a 10 percent chance of exceedence in 100 years, which corresponds to a recurrence frequency of 949 years. The corresponding upper-bound earthquake is estimated to include a mean magnitude of 7.2, located at a mean distance of approximately 4.5-miles from the site. The controlling seismic source is background seismicity assumed to occur anywhere in the region between known active faults.

4.1.3 Seismic Design Parameters

The proposed structures should be designed to resist the lateral forces generated by earthquake shaking in accordance with local design practice. This section presents seismic design criteria for use with the 2007 California Building Code (CBC).

The site seismic design criteria were determined based on the site latitude and longitude using the public domain computer software, NSHMP_HazardApp.jar, developed by the United States Geological Survey. Based on the subsurface conditions encountered at the site and the "Site Class Definitions" per the 2006 IBC/2007 CBC, we judged that Site Class C (very dense soil/soft rock) should be assumed for design. The following design parameters should be used for design in accordance with the 2007 CBC.

Table 3 - 2007 CBC Seismic Design Parameters

California Building Code, 2007 Section 1613	Seismic Parameter	Value
---	Latitude	35.32327
---	Longitude	-120.69383
Section 1613.5.2	Site Class Definition	Site Class C
Section 1613.5.1 and Figure 1613.5(3)	Mapped Acceleration Response Parameter (S_s) Site Class B	1.275
Section 1613.5.1 and Figure 1613.5(4)	Mapped Acceleration Response Parameter (S_1) Site Class B	0.479
Section 1613.5.2 and Table 1613.5.2	Soil Profile Type	(S_C), Dense soil/Soft rock
Section 1613.5.3 and Table 1613.5.3(1)	Site Coefficient (F_a)	1.00
Section 1613.5.3 and Table 1613.5.3(2)	Site Coefficient (F_v)	1.321
Section 1613.5.3	Adjusted Acceleration Response Parameter for Site Class C (S_{MS})	1.275
Section 1613.5.3	Adjusted Acceleration Response Parameter for Site Class C (S_{M1})	0.633
Section 1613.5.4	Design Spectral Response Acceleration Parameter (S_{DS})	0.850
Section 1613.5.4	Design Spectral Response Acceleration Parameter (S_{D1})	0.422

Note: S_S – Short Period (0.2 second), S_1 – Long Period (1.0 second)

4.2 LIQUEFACTION AND DYNAMIC DENSIFICATION

Settlement can occur as a result of seismic ground shaking due to liquefaction or densification of the subsurface soils. In both liquefaction and densification, ground shaking causes predominantly granular soils to become more compact, therefore, occupying less volume and resulting in settlement. Soils most susceptible to liquefaction and densification are loose to medium dense, clean, poorly graded, fine-grained sands, but some silty clayey soils of low plasticity are also known to be susceptible to liquefaction. Liquefaction can occur where soils are saturated (submerged) and is accompanied by a temporary loss of strength (i.e., the soil "liquefies"). Densification can occur where the soils are unsaturated. In general, liquefaction hazards are most severe in the upper 50 feet of the surface, except where slope faces or deep foundations are present (CDMG, 1998).

Based on the presence of shallow bedrock and the cohesive nature of the subsurface soils, it is our opinion that the potential for liquefaction at the site is very low.

4.3 CORROSION EVALUATION

Corrosivity testing for minimum resistivity, pH, chlorides, and sulfates was performed on seven (7) soil samples taken at depths of approximately 2.5 to 7.0 feet bgs. Resistivity and pH were estimated according to California DOT Tests 643, the sulfate content (SO_4) was determined using California DOT Test 417, and the chloride content (Cl) was estimated using the California DOT Test 422. The chemical tests were performed by Cerco Analytical of Concord, California and are summarized in Table B-1 in Appendix B.

In addition, two (2) in situ resistivity surveys were conducted within the MHCB site. For each of the two arrays, a Nilsson Model 400 4-pin Resistivity Meter was used to run tests at 2, 4 and 6-foot pin spacing.

The results of the corrosivity testing and in-situ resistivity survey showed the soil within the MHCB site to have a pH ranging from about 7.4 to 8.3 and a resistivity of between 680 and 1,700 ohms-cm. Soil from the parking area and Armory sites had a pH of approximately 8.2 and a resistivity of 1,900 and 1,400 ohms-cm, respectively. Chloride and sulfate levels were found to be low to non-detectable for all three sites.

Corrosivity test results presented by the previous studies discussed in Section 1.3, indicate a pH ranging from about 7.4 to 7.7 and a resistivity of between 725 and 2,000 ohms-cm (Fugro, 2005/Ninyo, 1998)

Caltrans currently defines a corrosive environment as an area where the soil and/or water contains more than 500 part per million (ppm) of chlorides, more than 2000 ppm of sulfates, has a minimum resistivity of 1000 ohm-cm or has a pH less than 5.5. As such, the site could be classed as being corrosive based on resistivity.

For specific long-term corrosion control design, a registered professional corrosion engineer should review the test results and soil types, and evaluate the need for implementing corrosion design measures for buried concrete and underground ferrous objects.

4.4 EXPANSION POTENTIAL

Our investigation indicates the presence of moderately to highly expansive clay throughout the project site. These expansive clays should be dealt with during grading and recommendations are given in Section 5.2, Site Preparation and Grading.

4.5 SOIL SHRINKAGE/SWELL POTENTIAL

In-place soil densities were obtained from soil samples retrieved from the exploratory borings. These densities were compared to available compaction test results in order to evaluate approximate soil shrinkage/swell potential after excavation and compaction. We expect most of the areas that are to receive structural fill will require a minimum of 90 to 95 percent (ASTM D1557) relative compaction. The actual average compaction, however, is typically greater than the specified minimum, and our experience indicates 2 to 3 percent over the required minimum. Therefore, selected samples have been evaluated against a relative compaction of 92 percent. Excluding anomalous values, the results indicate a calculated shrinkage factor ranging from –14 (bulking) to 5 percent (shrinkage). An average of -4 percent (bulking) was calculated for shallow soils in the uppermost 7 feet. The results are included in Appendix F, for reference.

5.0 RECOMMENDATION

5.1 GENERAL

Provided the recommendations presented in this report are followed, it is our opinion that the soils located within the relatively flat areas to be occupied by the proposed MHCB facility, parking area and Armory will generally be excavatable with conventional grading equipment. Excavation for improvements located within the southeastern topographic high area may require heavy-duty excavation equipment due to the presence of intensely to moderately weathered Franciscan Formation bedrock at approximately 5 feet bgs. Practical refusal to drilling was encountered at around 10 feet bgs in Boring B-12.

If site grading commences in the early spring or after a period of heavy rainfall, it is possible that the surface soil (predominantly in existing turf areas) may become saturated due to perching above underlying clays and shallow Franciscan bedrock trapping water near the surface. This may create loading, hauling, and fill placement difficulties. Often, a period of at least a month after the last heavy rain of the season is necessary to allow the surface soil to dry sufficiently so that heavy grading equipment can operate effectively. Due to the presence of expansive soils there is a potential that following the removal of existing pavements, the exposed subgrade materials may be above their optimum moisture content, and may be unstable.

5.2 SITE PREPARATION AND GRADING

Prior to commencement of general grading operations, all areas to be graded should be cleared of surface debris, soil stockpiles and organics, etc. All areas with vegetation should be stripped to a depth of 3 to 6 inches to adequately remove all roots and organics. Material resulting from stripping operations should not be used as structural fill. Stripping can be used as fill in landscape areas or non-structural/non-pavement areas, or it can be removed from the site.

Where placement of fill will be required and following grading preparation, the areas to receive fill should be scarified to a depth of 12 inches, moisture-conditioned to slightly above the optimum moisture content and re-compacted to a minimum of 90 percent relative compaction as determined by ASTM D 1557. Debris (including tree stumps/roots), if any, that are exposed during scarification should be removed from the site.

After scarification and recompaction, fill may be placed. Fills must be placed in horizontal lifts not exceeding 8 inches in loose lift thickness, with each lift compacted to a minimum of 90 percent relative compaction at slightly above the optimum moisture content. Fills that are greater than 10 feet thick should be entirely compacted to 95 percent relative compaction.

Where finished soil subgrade elevations are at existing grade, less than 2 feet below finished grade or in cut areas, the subgrade should lime treated to a depth of 12 inches to address the potential of expansive soils and compacted to not less than 90 percent relative compaction (ASTM D1557). The top 12 inches of soil subgrades beneath structural pavement, whether in areas of cut or fill, should be compacted to 95 percent relative compaction.

All cut/fill slopes within fill/alluvial soils should be graded no steeper than 3:1 horizontal-to-vertical (h:v). Track-walking is not an acceptable method of slope compaction. Fill slopes should be overbuilt and cut back to finished grade. Fill placed on slopes with a gradient steeper than 6:1 h:v must be provided with a base key cut into firm soil. The base key should extend below the existing ground surface a minimum of 2 feet into firm soil and should be a minimum of 10 feet wide. As fill is placed on the slope, benching should be provided at intervals frequent enough to remove the surface soil. Cut/fill slopes within intensely to moderately weathered Franciscan Formation materials may be graded up to 2:1 horizontal-to-vertical (h:v).

5.2.1 On-Site Soil and Imported Fill

Fill materials are expected to consist of site soils excavated during grading and from below grade structure areas. Based on the moderately to highly expansive nature of the site soils, as indicated by our laboratory test results, treatment will be needed to render site soils suitable for use as non-expansive fill material. Existing fill and native soil will also need to be free of concentrations of organic matter and debris, and screened to remove rock fragments greater than 4 inches in any dimension.

Treatment could comprise of lime treatment or the soils can be combined with a sufficient proportion of granular material to reduce the expansive nature of the soil. Materials resulting from the removal of the existing structural pavement to the parking lot could be used as a source of granular material for mixing with on site soils provided it was crushed/ground to an appropriate grading.

From a QA/QC perspective, lime treatment is the preferred option for treating on site soils, as the mixing of granular material to render on site soil non-expansive would require intense site supervision to ensure a quality product.

Imported soil, if required for use as engineered fill, should be reviewed and approved for use by the project geotechnical engineer prior to transporting to the site. In general, imported soil should be granular (less than 50 percent passing the No. 200 sieve), have a Plasticity Index (P.I.) less than 15 and be screened so that the maximum particle size does not exceed 4 inches and contains no more than 15% larger than 2.5 inches.

5.2.2 Soil Stabilization

If unsuitable material (such as expansive and/or soft/loose/yielding soil) is encountered during subgrade preparation, such as in Boring B-1 to 6.5 feet bgs, it should be stabilized prior to placement of fill or aggregate base (AB). Yielding soil conditions can typically be stabilized using one of the methods listed below; however, soil conditions and mitigation methods should be reviewed and approved by the project geotechnical engineer when encountered.

Option 1) Deep scarify and allow to air dry to near optimum moisture content and recompact in accordance with the project specifications for fill placement.

Option 2) Remove wet soils to a firm base and allow the wet soil to dry to near optimum moisture content and/or replace with drier soil.

Option 3) Lime or cement treat to reduce the moisture content. For dry-back, typical lime and/or cement quantities of 2% to 4% are commonly used. Mixing and pulverization using disc harrows or rotary mixers may be required to achieve a treated material with even distribution of lime and/or cement (no streaks or pockets of lime/cement).

In pavement areas, travel on treated subgrade should be minimized for a period of 24 - 48 hours to avoid initiating pumping conditions. A test section should be proof rolled with heavy rubber-tired equipment to determine if the subgrade will be stable enough for construction to proceed. If severe subgrade yielding (yielding which may create pumping conditions during base and asphalt placement) is observed, work should be stopped and determination of the appropriate procedures for continuing work should be made by the project geotechnical engineer.

Option 4) In pavement or slab areas, yielding soils can be removed to a firm base or 2 feet below subgrade elevation, whichever is less. The bottom of the overexcavated area should be observed by the project engineer. If the bottom of the overexcavated area is soft or wet, a layer of stabilization fabric (such as Mirafi 500X or equivalent) should be placed and the over excavation backfilled with a coarse crushed rock (3 inch minus) or Class 2 aggregate baserock compacted in accordance with the project specifications for fill placement. If the bottom of the excavation is firm and relatively unyielding, it may be backfilled with native soil (lime treated native soil in building pad and pavement areas) or approved imported soil placed and compacted in accordance with the project specifications for fill placement. If loose/soft soils indicative of those encountered in the upper 6.5 feet of Boring B-1 are identified within heavy slab areas or footing excavations, the footing should be deepened to extend through loose/soft soil or the soils should be reworked and recompacted.

5.3 FOUNDATIONS

Provided our grading recommendations are followed, it is our opinion that the proposed MHCB facility and Armory to be constructed within the northwestern portion of the project site can be supported on shallow strip or spread footings founded on engineered fill and/or native undisturbed soil/ highly weathered rock.

All strip, interior and exterior footings should be embedded a minimum of 24 inches below the lowest adjacent finish grade to account for the expansive nature of the existing fill and alluvial soils encountered during our investigation. Footings should be a minimum of 12 inches wide and sized not to exceed an allowable bearing capacity of 3,000 pounds per square foot (psf) for dead plus live loads. In areas of shallow weathered Franciscan Formation, footings should be founded a minimum of 12 inches below the lowest adjacent finish grade and a higher allowable bearing capacity of 6,000 psf can be assumed. The allowable bearing capacities were calculated assuming a Factor of Safety of 3 and may be increased by 33 percent for transient loading such as from wind or a seismic event.

To avoid differential settlements, foundations should not span across existing fill/alluvium and the more competent Franciscan Formation material. If footings need to span across these materials, then it is recommended that the project geotechnical engineer review the site condition to determine whether the foundation materials need to be over-excavated and replaced with a uniform layer of compacted engineered fill or the foundation needs to be deepened to be founded on a uniform material.

Footing excavations should be cleared of loose soil and construction debris prior to the placement of concrete. The project geotechnical engineer should be allowed to observe footing excavations prior to placement of concrete or reinforcement.

Reinforcement of the footings should be determined by the design structural engineer. As a minimum, perimeter footings should be reinforced with two No. 5 bars, one near the top and one near the bottom of the footing. A minimum of 3 inches of concrete coverage should be maintained around all of the reinforcing bars. However, corrosive soil environments may require additional cover or concrete protection.

If foundations are designed in accordance with the recommendations above, we estimate total settlement for building foundations to be on the order of 1/4 to 1/2 inch. Differential settlements should be less than 1/4 inch over a distance of approximately 30 to 50 feet.

5.3.1 Guard Towers

In order to resist uplift loads, we recommend that the guard towers to be constructed within the existing parking lot (flat area) be supported by drilled piers. The piers should be a minimum of 12 inches in diameter and embedded a minimum of 5 feet into the prepared subgrade. The ultimate load capacity of piers should be based on a skin friction of 750 psf and a factor of safety of 2.5 should be applied to calculate allowable load capacity. The upper 2 feet of the pile should be ignored when calculating the uplift resistance of the pile. The calculated allowable uplift load for a 12 inch diameter pier embedded a minimum of 5 feet into the prepared subgrade is around 2.8 kips. The allowable uplift resistance can be estimated at 80% of the vertical capacity of the pier.

For guard towers located in the area of higher ground on the southeast side of the project site where shallow Franciscan Formation was identified, a mass footing designed assuming an allowable bearing capacity of 6,000 psf may be suitable to provide the necessary uplift resistance.

5.3.2 Lighting Poles

Foundations for light poles and other pole-supported structures may be designed using the formula in the California Building Code. Where light poles will not be adversely affected by ½ an inch of lateral motion at the ground surface due to short-term lateral loading, an allowable lateral soil-bearing pressure of 250 psf per foot of depth is applicable. For an acceptable lateral motion of about ¼-inch at the ground surface due to short-term lateral loading, allowable lateral soil-bearing pressure of 125 psf per foot of depth is applicable. These pressures are valid provided fill is placed as recommended.

5.3.3 Interior Slabs-on-Grade

Conventional concrete slab-on-grade floors are suitable for the proposed Armory and MHCB prepared as recommended herein. Interior concrete slabs-on-grade should be a minimum of 4 inches thick in areas subjected to floor loads of less than 250 psf and a minimum of 5 inches thick where floor loads are equal to or greater than 250 psf.

The slab should be underlain by the prepared subgrade, i.e. lime treated, in addition to 4 inches of washed, compacted, crushed rock overlain by a 12-mil vapor barrier. The vapor barrier should be overlain by a minimum of 2 inches of clean sand. The sand should be compacted before concrete is placed. Wetting the sand the day before will serve to compact the sand; however, the sand should be free of "drainable" water at the time concrete is placed. In slab areas that will not be sensitive to moisture migration through the slab, an alternative to the vapor barrier would be to underlay the slab with 6 inches of washed, compacted, crushed rock. Crushed rock used beneath floor slabs should be graded so that 100 percent passes the 0.75 inch sieve and less than 5 percent passes the No. 4 sieve. Crushed rock should be compacted with a minimum of 3 passes with a vibratory type compactor.

If additional moisture protection is desired, a higher quality vapor barrier conforming to the requirements of ASTM E 1745 Class A, with a water vapor transmission rate less than or equal to 0.006 gr/ft^2/hr (i.e., 0.012 perms) per ASTM E 96 (e.g., 15-mil thick Stego Wrap Class A) may be used in place of the retarder. During construction, all penetrations (e.g., pipes and conduits), overlap seams, and punctures should be completely sealed using a waterproof tape or mastic applied in accordance with the vapor retarder manufacturer's specifications. The vapor retarder or barrier should extend to the perimeter cutoff beam. The vapor retarder or barrier should be placed directly under the slab foundation, or at the structural engineer's option, the retarder or barrier may be covered with 2 inches of sand. If used, sand should be lightly moistened just prior to placing the concrete.

The required slab thickness and reinforcement should be determined by the design engineer. Reinforcement should consist of a minimum of No. 4 bars on 18 inch centers going both ways. Hooking and pulling of reinforcement during concrete placement is not recommended.

Some floor coverings are sensitive to moisture that can be transmitted through the slab. Where these floor coverings are used, the slab should be tested for moisture transmission and/or waterproofed as recommended by the flooring manufacturer.

Foundation dimensions, minimum slab thickness, and reinforcing details recommended herein are based upon geotechnical and construction considerations and are not offered in lieu of foundation design by an engineer.

5.3.4 Exterior Slabs-On-Grade

Exterior flatwork, such as sidewalks, may be placed directly on the prepared subgrade, i.e. lime treated, without the use of rock underlayment.

The subgrade should be free of any debris, uniformly compacted and thoroughly wetted before the concrete is placed. Reinforcement, as determined by the structural engineer, may be needed in areas subjected to unusually heavy loads.

5.4 LATERAL RESISTANCE

Lateral earth pressures will be used in the design of retaining walls, buried structures, pipelines, and for determining passive resistance at footings. Active and at-rest pressures should be calculated based on the equivalent fluid weights provided below and on the pressure diagrams shown in Plate 6, which include both static and earthquake induced pressures. For non-yielding walls, residual lateral earth pressures due to compaction equipment should be included, as indicated on Plate 6. Typical values of lateral pressure due to compaction equipment are 250 psf for plate compactors, 400 psf for light vibratory compactors (such as a Dynapac CA12PD), and 1000 psf for heavy vibratory compactors (such as a Dynapac CA25PD). Lateral pressures due to compaction equipment can be maintained below 400 psf by using compaction equipment with line loads (static plus dynamic) less than 350 pounds per inch within 6 feet of the wall being backfilled; heavier equipment can be used without restriction at distances greater than 6 feet from the wall. Backfill within 0.5 feet of the wall should be compacted using vibratory plate compactors. If necessary during construction, other compaction equipment load/distance combinations can be evaluated for use behind the wall.

For shallow foundations (i.e. structural slabs or spread footing), lateral load resistance can be developed by bottom friction under the floor slab and footing, as well as side friction between the below-grade walls and surrounding soil. Under long-term static loading, an ultimate bottom friction coefficient of 0.35 and 0.45 is recommended for foundations supported on native soils and on compacted Class 2 Aggregate Base directly over native soils, respectively. For side friction, an ultimate frictional resistance equal to 0.45 times the at-rest horizontal pressure (excluding the earthquake pressure) on the below-grade walls is recommended, assuming that import fills used for backfill materials consist of silty, sandy gravel.

In addition to side and bottom resistances, below-grade structures will also develop lateral load resistances through passive soil pressures acting against the below-grade walls and foundations. Distribution of the equivalent fluid passive resistance should be taken from the adjacent ground surface level. The total passive resistance acting on the uppermost foot should be ignored unless it is confined by slab or pavement, and the passive resistance of the soil should be limited to 3,500 psf. The equivalent fluid weights provided in the table below may be used for design of the proposed structures with horizontal backfill. The drained condition assumes that the backfill behind the wall is adequately drained to avoid saturation and introduction of hydrostatic pressure.

Positive drainage for walls should consist of material equivalent to Caltrans-specified Pervious Backfill Material (Section 19-3.065) or a vertical layer of permeable material, such as coarse sand or pea gravel at least 6-inches thick, positioned between the wall and the backfill. If pea gravel is used, a non-woven filter fabric should be placed between it and the backfill to prevent the pea gravel from becoming clogged. Pervious backfill material should be placed in accordance with Caltrans, Standard Plan B0-3, and Standard Specifications 19-3.065 and 51-1.15.

A synthetic drainage fabric, such as Enkadrain or equivalent, may be substituted for the gravel or sand layer, if desired. Care must be taken during installation to assure that the filter part of the material faces the backfill. Collected water may be removed either by installing weep holes along the bottom of the wall or by installing a perforated drainage pipe along the bottom of the permeable material continuously sloped towards suitable drainage facilities.

Table 4. Equivalent Fluid Weights

Condition	***Drained Backfill (pcf)***	***Undrained Backfill (pcf)***
Active Condition	40	80
At-Rest Condition	65	95
Passive Condition	350	250

In the design of retaining structures, if any surface loads are closer to the edge of the retaining wall than half of the height, then the design wall pressure should be increased by 0.30q over the whole area of the retaining wall. In this expression, q is the surface surcharge load in psf.

The aforementioned values are ultimate values, considering various amounts of wall and/or footing deflection. It is the responsibility of the structural engineer to choose appropriate safety factors when converting ultimate resistance values to allowable.

5.5 PAVEMENT

Three R-Value tests were performed on fill/alluvial soils for the design of the pavement structural sections, resulting in a selected design R-Value of less than 5. If pavement is to be placed on lime treated subgrade, a design R-Value of 25 may be assumed.

A traffic index (TI) of 4.5 was selected as appropriate for automobile parking areas and a TI of 5.5 for fire truck access. The TI is a measure of wheel load, frequency, and intensity. We have recommended structural sections for the range of TI values listed above. Use of the proper TI values should be confirmed by the project designers. If imported soils are used to raise site grades, confirming R-value tests should be performed on imported soils planned for pavement surfaces and, if required, the pavement section should be revised based on the new R-value.

Table 5. Recommended Pavement Section (Design R-value < 5)

TI	***Asphalt Concrete (Inches)***	***Class 2 Aggregate Base (Inches)***
4.5	2.5	9
5.5	3	12

Table 6. Recommended Pavement Section on Lime Treated Subgrade (Design R-value = 25)

TI	***Asphalt Concrete (Inches)***	***Class 2 Aggregate Base (Inches)***
4.5	2.5	5.5
5.5	3	8

No concrete curbs and gutters will be provided where concrete sidewalks are adjacent to paved areas. Concrete sidewalks will be sloped for drainage away from the building.

Pavement areas should be sloped at a gradient of 2 percent or greater to allow for positive surface drainage. Both positive surface slope and uniform compaction are necessary for proper pavement performance.

These pavement sections are based on the assumption that the top 12 inches of native prepared subgrade soil or fill and aggregate base is uniformly compacted to 95 percent or higher relative compaction. Adequate surface slope, subgrade crown, and uniform compaction contribute to long-term pavement performance.

It is important that the drainage of pavement areas be designed so that water is not allowed under the paved areas. If water is trapped under paving the water can saturate the base course and soil subgrade, which could result in premature pavement failures. Screened slots or weep holes should be placed in drop inlets in pavement areas to allow free drainage of the adjoining base course materials. Curbs, gutters, dikes, and drop-inlets should be provided as needed to control pavement runoff and reduce the potential for undermining of the edge of pavement.

Cutoff curbs should be installed where pavement abuts landscape areas. These cutoff curbs should extend to a minimum depth of 4 inches below pavement subgrade to reduce the amount of water that can seep beneath the pavement. Where cutoff walls are undesirable, subgrade drains can be constructed to remove excess water from landscape areas or an impermeable barrier, such as 20 mil HDPE, could be placed at the back of curb to a depth of approximately 1-foot below subgrade.

5.6 DRAINAGE

Proper drainage is important in the development of the project. Final grading adjacent to structures should be sloped at a minimum of 2 percent so that the surface water drains away from the buildings. Final backfill placed adjacent to building foundations should be free of construction debris, properly compacted, and sloped so that storm or irrigation water is not allowed to pond or rest next to the footings. Landscape grading should be designed so that surface water is directed to properly designed drainage facilities. Roof drainage should be designed so that water is directed toward appropriate storm drainage inlets and is not allowed to fall onto soil directly adjacent to footings.

5.7 UTILITY TRENCHES

Where utility trenches enter building pads, the trenches should be backfilled with an impermeable plug at the exterior wall foundation. The plugs can be formed of compacted clayey soil, compacted bentonite, or cement bentonite/sand-cement slurry. The plugs should be at least 2 feet thick and extend from 1-foot below the ground surface to at least 2 feet beyond the base of the adjacent footing.

Dewatering is not anticipated to be necessary for installation of utility lines less than 5 feet deep. This assumes that construction takes place in the drier months of the year when the surface soil is not saturated and there is no surface water on the site.

Utility trenches should be backfilled with approved import. Import material for trench backfill should be approved by the project geotechnical professional at least 48 hours prior to transporting to the site.

Trench backfill should be compacted by mechanical methods to a minimum of 90 percent relative compaction beneath structure foundations, 95 percent beneath structural pavement areas and 85 percent in landscape areas. Jetting is not an acceptable means of compaction. We recommend maximum lift thicknesses of 1-foot in structural areas and 2 feet in landscape areas. The project geotechnical professional should be allowed to observe the backfill and compaction procedures.

Utility trenches should be excavated according to accepted engineering practice, following the Occupational Safety and Health Administration (OSHA) standards by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be minimized.

5.8 GENERAL EROSION CONTROL

The erosion potential of the soil on or near the surface of the subject site is considered to be low to moderate. Erosion control measures should be implemented during and after construction to minimize soil erosion. This can be accomplished during construction using the following methods:

- Site grading should be scheduled to avoid periods of heavy rains whenever possible.
- Temporary slopes should be maintained at the flattest possible gradient.
- During the rainy season, exposed soil on sloping ground should be covered as soon as possible. Covers could consist of grass and/or mulch (straw, wood chips, manmade fibers, etc.).
- Water flow over areas disturbed by grading should be minimized. This can be accomplished by placing temporary earth berms at the top of sloped areas.
- Dust should be controlled by sprinkling areas of exposed soil.
- If appropriate, debris basins should be constructed to trap debris and silt prior to entering drainage channels. Hay bales can be used as silt traps along drainage channels and at drop inlets.

Following construction, exposed soil should be vegetated (planted with grasses or shrubs) or covered with a mulch or erosion control fabric to minimize soil erosion. Concentrated flows should be directed away from slopes and be piped or channeled into suitable drainage facilities.

6.0 ADDITIONAL GEOTECHNICAL SERVICES

Fugro should review geotechnical aspects of the plans and specifications to check for conformance with the intent of our recommendations. The analyses, designs, opinions, and recommendations submitted in this report are based in part upon the data obtained from the subsurface explorations conducted for the CMC MHCB Project, and upon the conditions existing when services were conducted. Variations of subsurface conditions from those analyzed or characterized in the report are possible, as may become evident during construction. In that event, it may be advisable to revisit certain analyses or assumptions.

We recommend that Fugro be retained to provide geotechnical services during site grading and foundation installation to observe compliance with the design concepts, specifications and recommendations presented in this report. Our presence will allow us to modify design if unanticipated subsurface conditions are encountered. During construction, our field engineer should observe and/or test the following:

- Soil conditions exposed by site grading, to confirm that they are consistent with those encountered during the field exploration;
- Foundation installation operations; and
- Fill placement and compaction, including subgrade preparation, and backfill of utilities.

7.0 LIMITATIONS

The analyses, conclusions, and recommendations contained in our report are based on site conditions as they existed at the time of our investigations, and further assume that probes such as exploratory borings are representative of the subsurface conditions throughout the site; i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the probes.

Unanticipated subsurface conditions are commonly encountered and cannot be fully determined by exploratory borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project.

If during construction different subsurface conditions from those encountered during our exploration or different from those assumed in design are observed or appear to be present, or where variations from our design recommendations are made, we must be advised promptly so that we can review these conditions and modify the applicable recommendations if necessary. We cannot be held responsible for differing site conditions, changes in design, or modified geotechnical recommendations not brought to our attention.

This geotechnical investigation did not include an investigation regarding the existence, location, or type of possible hazardous materials. If an investigation is necessary, we should be advised. In addition, if any hazardous materials are encountered during construction of the project, the proper regulatory officials should be notified immediately.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference" as that latter term is used relative to contracts or other matters of law. We can neither vouch for the accuracy of information supplied by others, nor accept consequences for unconsulted use of segregated portions of this report.

8.0 REFERENCES

Blake, T.F., 2000, EQFAULT, A Computer Program for the Deterministic Prediction of Peak Horizontal Acceleration from Digitized California Faults, Version 3.0.

Blake, T.F., 2000, EQSEARCH, A Computer Program for the Estimation of Peak Accelerations from California Historical Earthquake Catalogs.

Blake, T.F., 2000, FRISKSP, A Computer Program for the Probabilistic Estimation of Peak Acceleration, Version 4.00.

Boore, D.M., Joyner, W.B., and Fumal, T.E., 1997, Equations for Estimating Horizontal Response Spectra and Peak Acceleration from Western North American Earthquakes: A Summary of Recent Work, Seism. Res. Let., V.68, No.1, p.128-153.

California Building Code (CBC), 2007, California Code of Regulations, Title 24, Part 2, Volume 2, by the California Building Standards Commission.

California Division of Mines and Geology (CDMG), 1998, Guidelines for Evaluating and Mitigating Seismic Hazards in California; Special Publication 117.

California Geological Survey (CGS), 2002, Appendix A – 2002 California Fault Parameters (updated Appendix A of DMG Open-File Report 96-08, Probabilistic Seismic Hazard Assessment for the State of California, 1996).

Fugro West, Inc., 2005, Geotechnical Report, California Men's Colony Water System Upgrade, San Luis Obispo, California.

Hall, C.A., and Prior, S.W., (1975), Geological Map of the Cayucos-San Luis Obispo Region, San Luis Obispo County, California, United States Geological Survey, Map MF-686.

Hart, E.W. and Bryant, W.A., 1997, Fault-Rupture Hazard Zones in California: California Department of Conservation, Division of Mines and Geology, Special Publication 42.

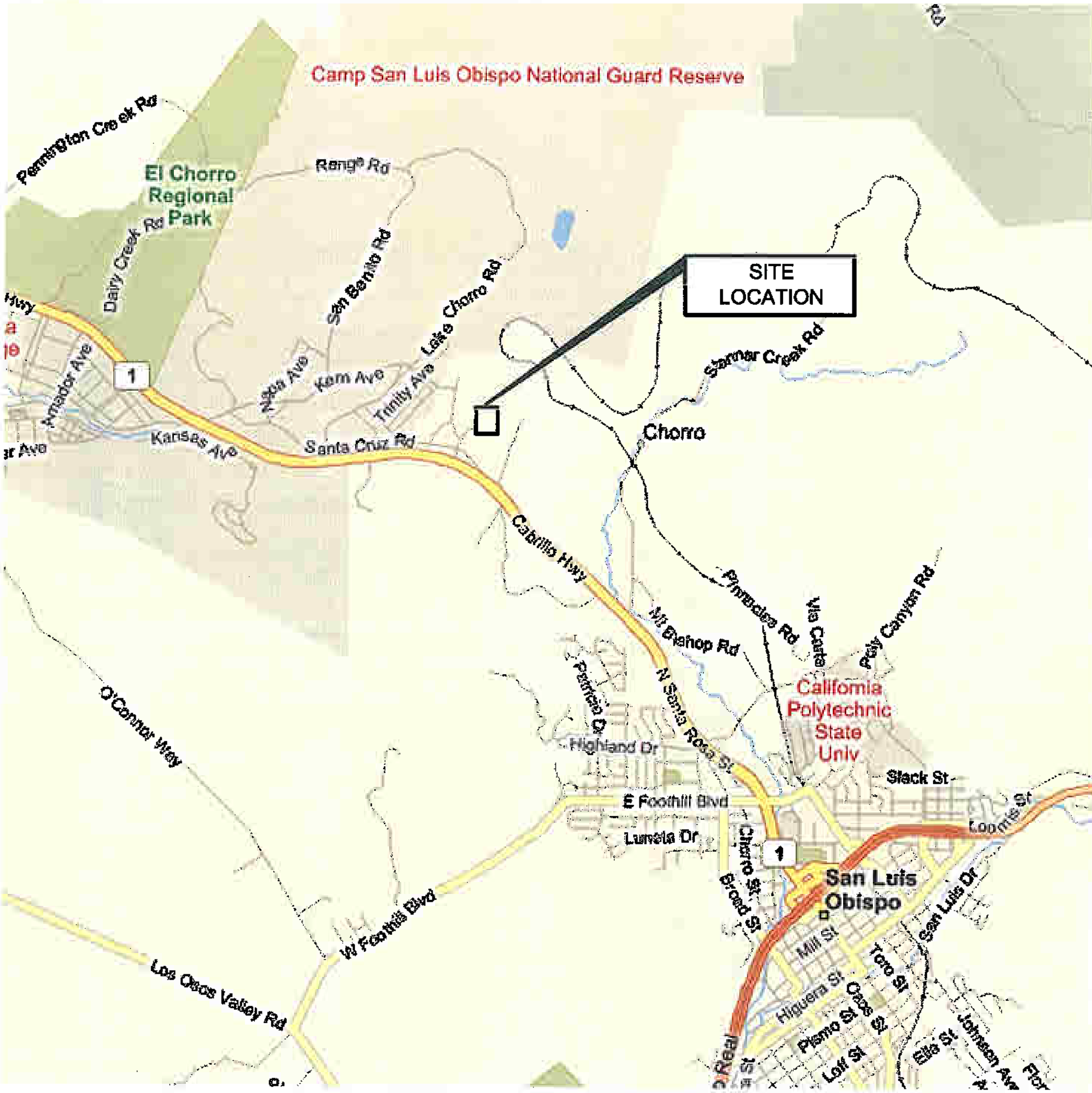
Hinds N.E.A. (1952), "Evaluation of the California Landscape, California," Division of Mines and Geology Bulletin 158, 240 pp.

Ninyo & Moore Geotechnical and Environmental Sciences Consultants, 2005, Geotechnical Report California Men's Colony (East) San Luis Obispo, California

Norris, R.M. and Web, R.B. (1990), Geology of California, 2nd Edition, published by John Wiley & Sons, Inc., pp. 359-411.

Occupational Safety and Health Administration, Department of Labor, October 1989, Federal Register Part II- 29 CFR 1926 Occupational Safety and Health Standards-Excavations; Final Rule.

PLATES



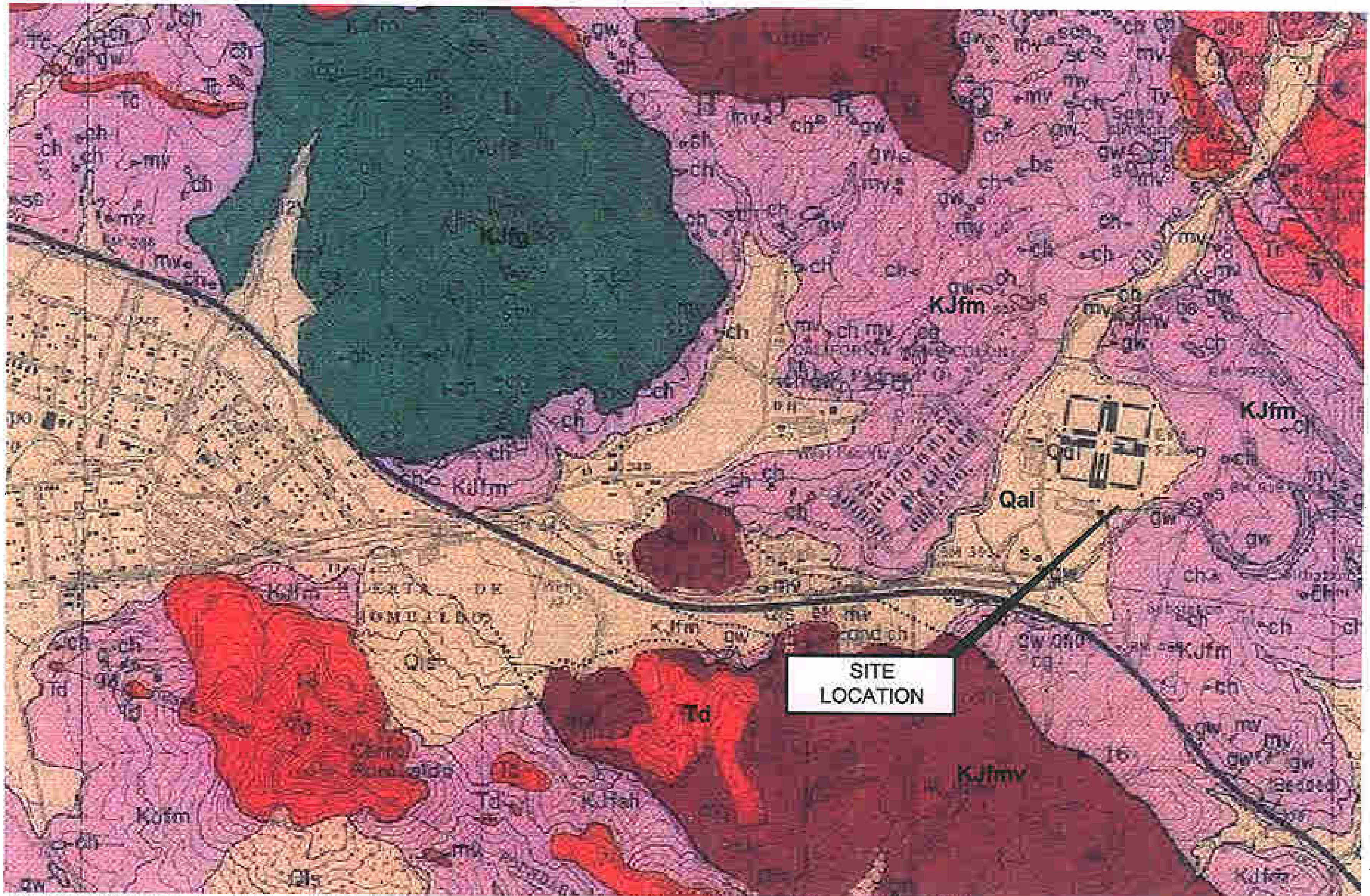
SOURCE: This Vicinity Map was based on Bing Maps

VICINITY MAP

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

PLATE 1

G:\Jobdocs\1766\1766.005\Drawings\Geo map (Plate 2).dwg 8-07-09 03:34:00 PM SacCad



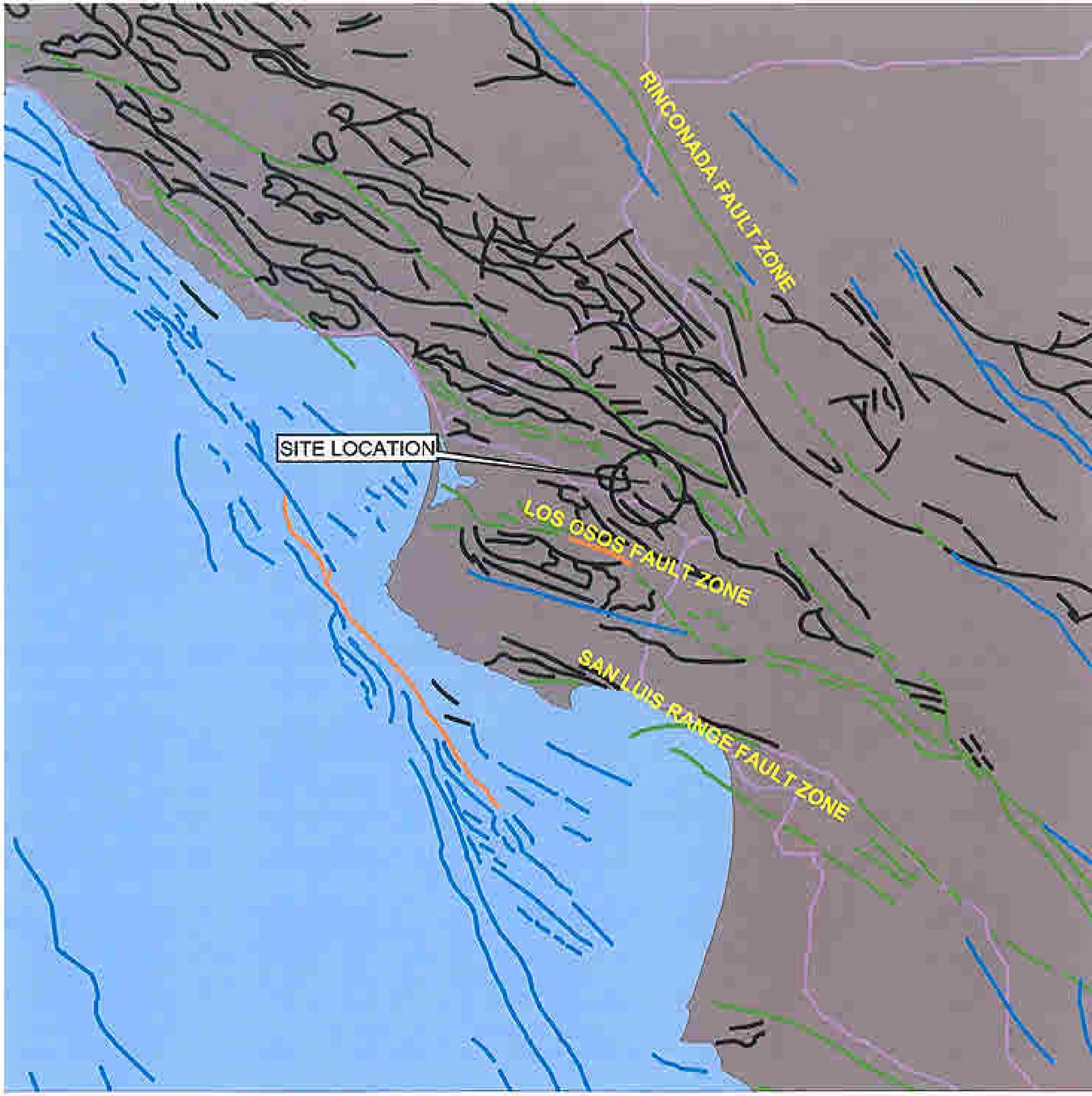
BASE MAP SOURCE: Geologic Map of the San Luis Obispo-San Simeon Region, California (Hall, Earnst, Prior, and Wiese, 1979)

LEGEND

Qal	Alluvial deposits	bs	blueschist
Td	Dacite, porphyritic-asphaltic dacite	mv	metavolcanic rocks or greenstone
Franciscan Formation:		ch	white, red, or green chert
KJfg	Graywacke	gw	graywacke
KJfmv	Metavolcanic rocks	s	serpentinite
KJfm	Melange, metamorphosed basalt and diabase	sc	silica-carbonate rocks

GEOLOGIC MAP
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

PLATE 2



SOURCE: California Division of Mines and Geology (California Geological Survey)

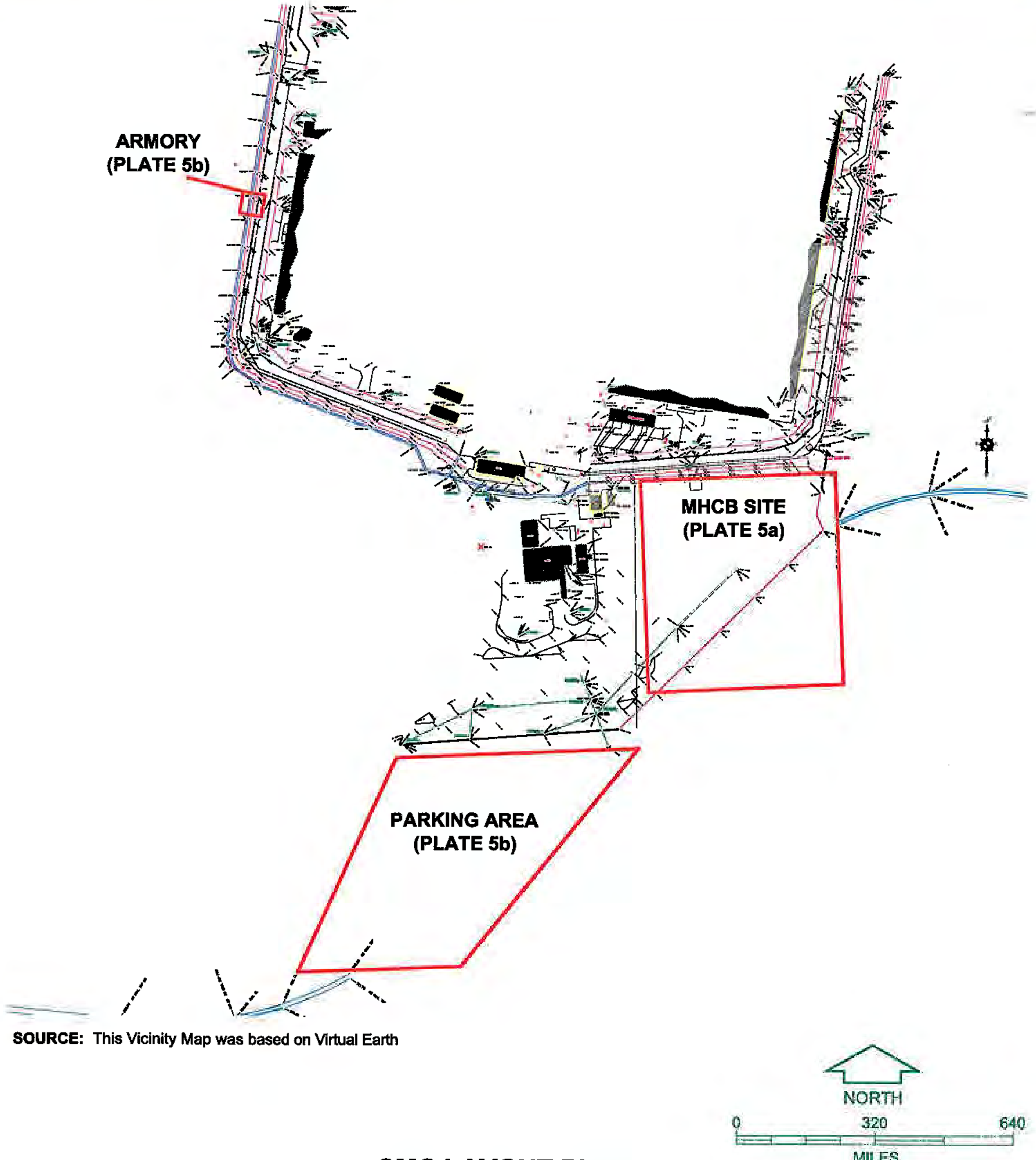
NORTH

0 7 14
MILES

LEGEND

- HISTORIC
- HOLOCENE
- LATE QUATERNARY
- QUATERNARY
- PREQUATERNARY

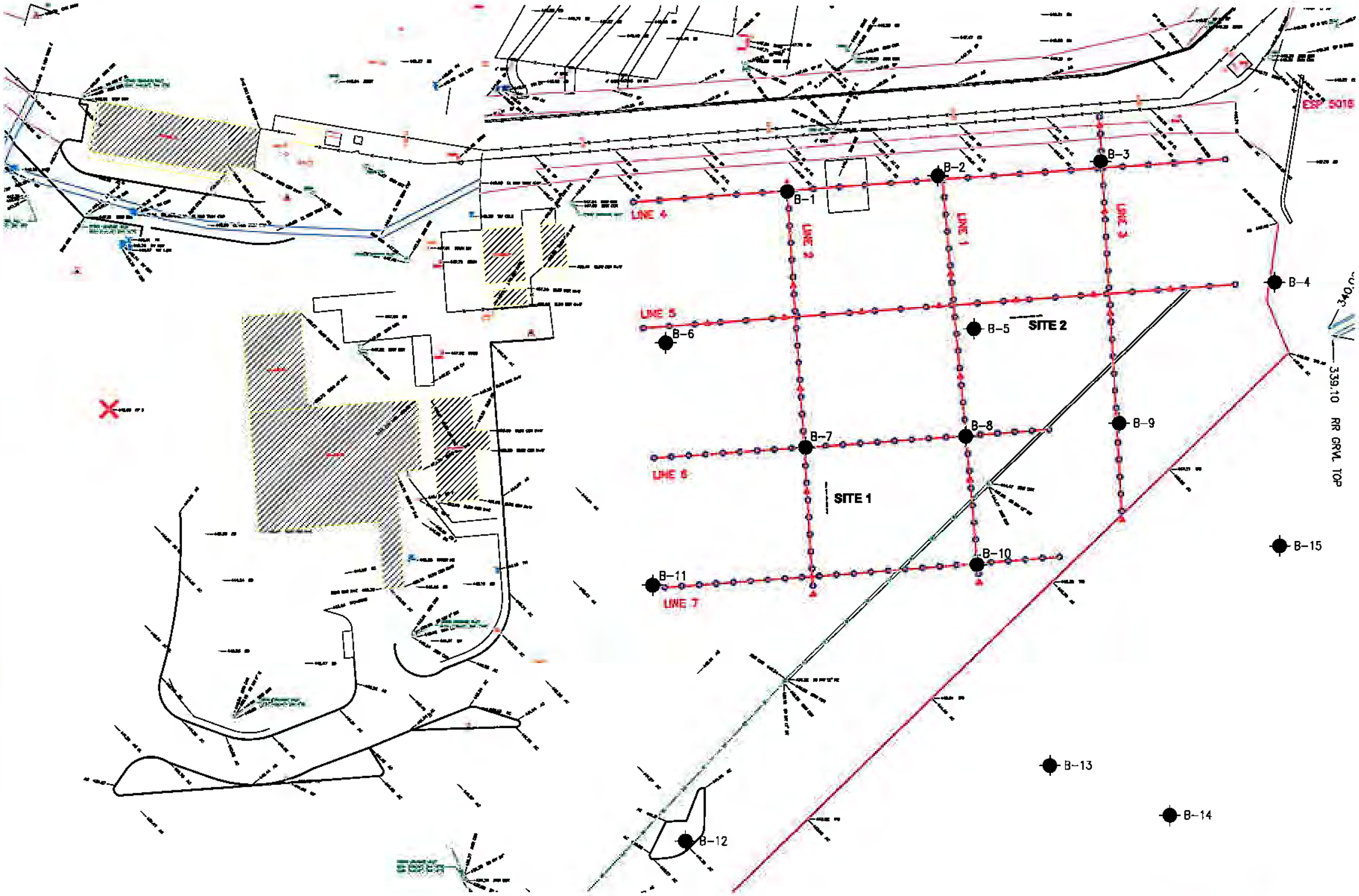
REGIONAL FAULT LOCATION MAP
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California



SOURCE: This Vicinity Map was based on Virtual Earth

CMC LAYOUT PLAN
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

G:\Jobdocs\1766\1766.005\Drawings\Boring location map (Plate 5a).dwg 8-07-09 03:34:46 PM SacCad



BASE MAP SOURCE: This boring location map is based on a Google Earth image.

LEGEND

- B-1 LOCATION OF EXPLORATORY BORING
- LOCATION OF ReMi/REFRACTION SURVEYS
- SITE 1 LOCATION OF IN-SITU RESISTIVITY SURVEYS

MHCB BORING LOCATION MAP

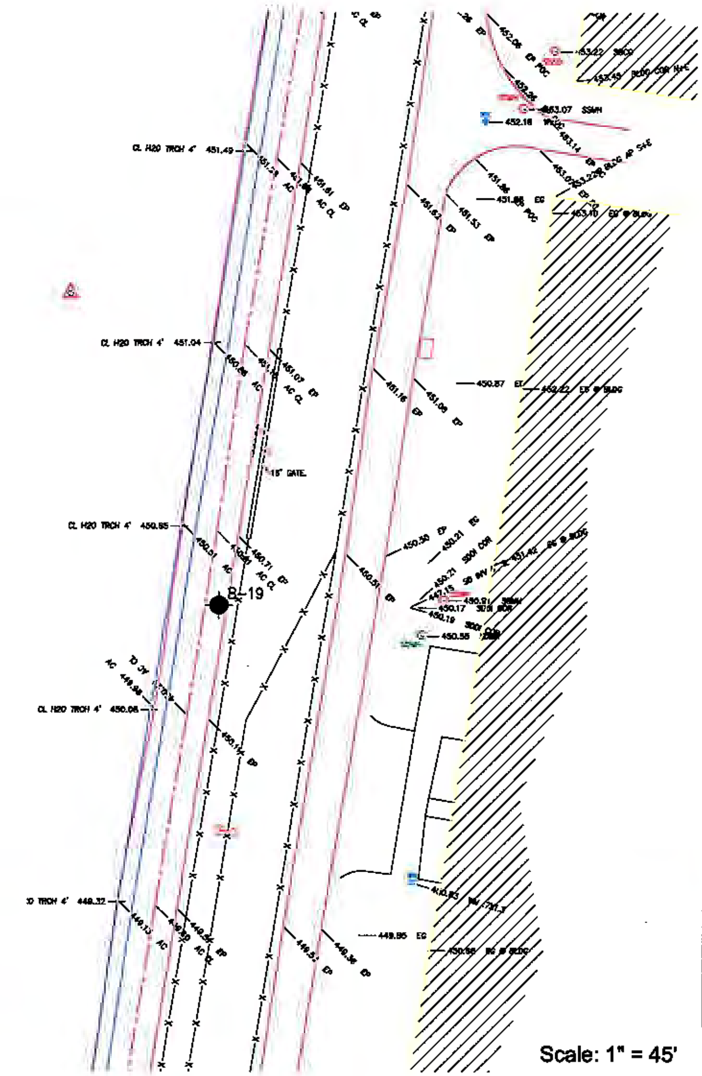
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

NORTH

0 90 180
FEET

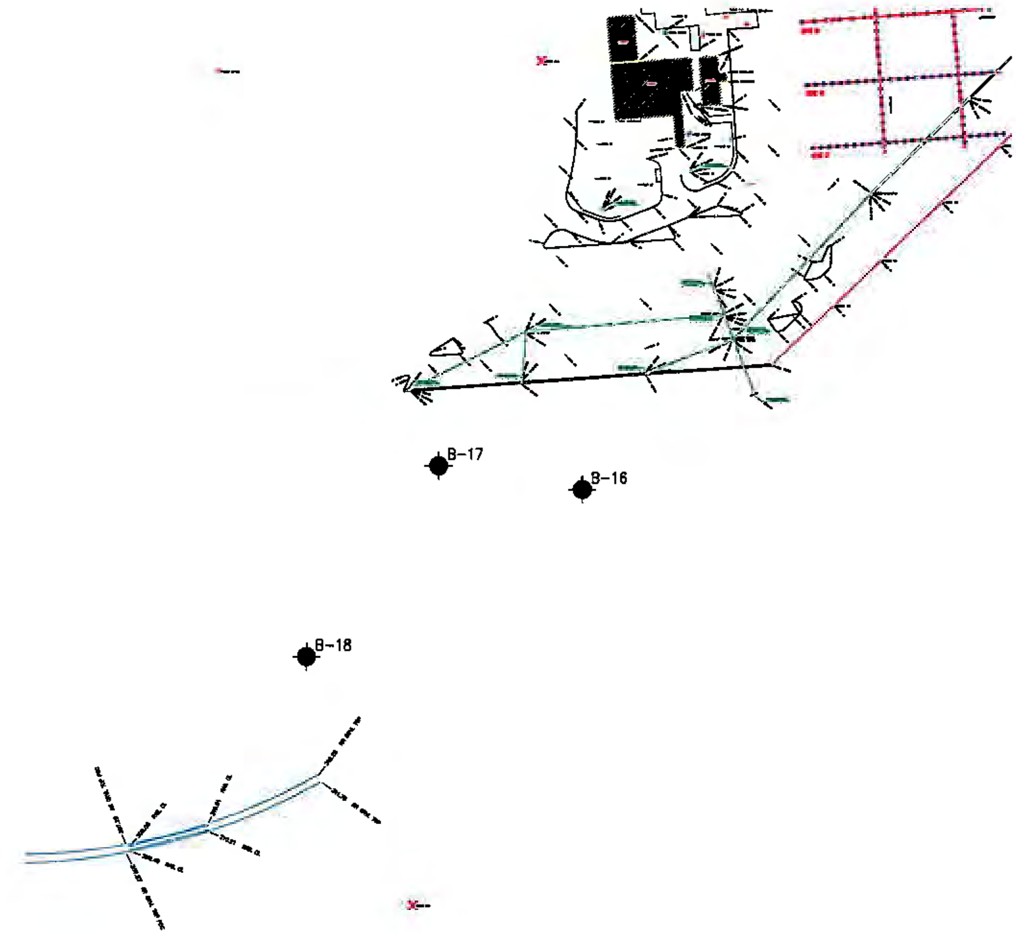
G:\Jobdocs\1766\1766.005\Drawings\Boring location map (Plate 5b).dwg 8-07-09 03:35:59 PM SacCad

August 2009
Project No. 1766.005



Scale: 1" = 45'

ARMORY BORING



Scale: 1" = 230'

PARKING AREA BORINGS

BASE MAP SOURCE: This boring location map is based on a Google Earth image.

LEGEND

B-1 APPROXIMATE LOCATION OF EXPLORATORY BORING

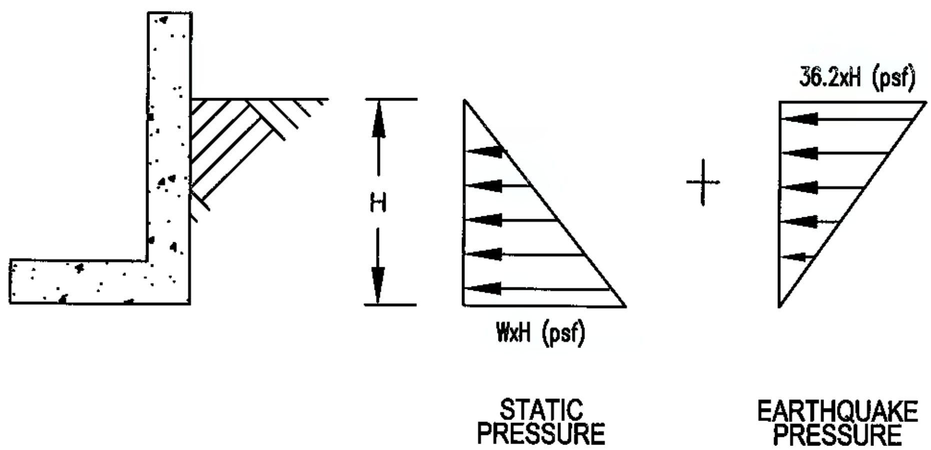
NORTH

PARKING AREA / ARMORY BORING LOCATION MAP

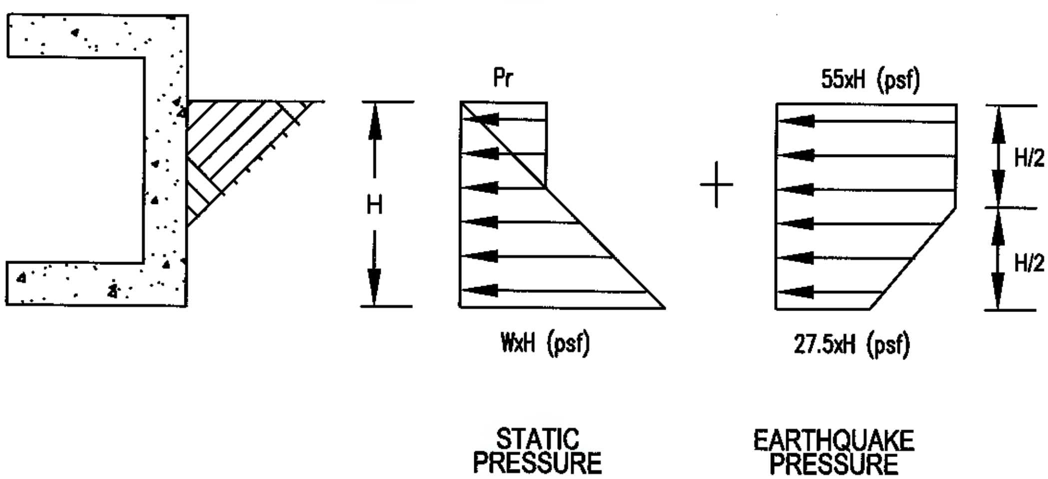
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

PLATE 5b

ACTIVE PRESSURE DISTRIBUTION
(YIELDING WALLS)



AT-REST PRESSURE DISTRIBUTION
(NON-YIELDING WALLS)



NOTE : W = Equivalent Fluid Weight of soil.
Pr = Pressure due to compaction of backfill against non-yielding walls. Typical values are:
Heavy vibratory rollers: 48kPa (1000 psf); Light vibratory rollers: 19kPa (400 psf); Plate compactors: 12kPa (250 psf)

LATERAL EARTH PRESSURES
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

APPENDIX A

FIELD EXPLORATION

FIELD EXPLORATION

Field investigation work was conducted in June 2009. Fieldwork consisted of drilling and sampling nineteen (19) exploratory borings to depths of 5 to 30 feet bgs, two (2) in-situ resistivity surveys and seven (7) ReMi seismic surveys, four of which doubled as refraction surveys. The data obtained from the borings are presented as logs on Plates A-1 through A-19. A legend to the boring log terms and symbols is presented as Plate A-20. Work was performed in general accordance with appropriate ASTM field exploration and sampling standards.

The borings were drilled by S/G Drilling with a truck-mounted CME 75 drill rig using a 8" hollow stem auger (HSA). The borings were completed by backfilling with cuttings and placement of a surficial cold patch.

Representative soil samples were obtained from the borings using a Modified California split-barrel drive sampler (outside diameter of 3.0 inches, inside diameter of 2.5 inches) and a Standard Penetration Test (SPT) split-barrel drive sampler (outside diameter of 2.0 inches, inside diameter of 1.375 inches). Both sampler types are indicated in the "Sample Type" column of the boring logs as designated in Plate A-20. Bulk samples were taken from the cuttings and collected in plastic bags as the drilling progressed. All samples were transmitted to our laboratory for evaluation and appropriate testing.

The samplers were driven a depth of 18 inches by dropping a 140-pound hammer through a 30 inch free fall using an automatic hammer system. The resistance blow counts were recorded for each 6 inches of penetration. The resistance blow counts for the initial 6 inches of penetration were considered as seating blows and only the resistance blow counts for the last 12 inches of penetration were used for the field blow count. If the test was curtailed due to hard driving, defined as 50 blows for less than 6 inches penetration, the number of blows to achieve actual penetration were recorded, e.g. 50 blows for 4 inches. Penetration resistance values presented on the boring logs are direct values measured in the field. Due to the greater efficiency of the automatic hammer system, the resistance blow counts recorded for the last 12 inches of penetration for a SPT sampler need to be multiplied by a factor of about 1.3 to approximate SPT N-values. When driving a Modified California split-barrel sampler using an auto hammer, the resistance blows for the last 12 inches of penetration are considered approximately equal to SPT N-values.

The locations of the exploratory borings were determined using the topographic survey provided by Nacht & Lewis Architects. The accuracy of the boring locations and elevations can only be implied to the degree that these methods warrant.

Surface Elevation: 448.0 ft	**Date Drilled:** 06/23/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 16.0 ft BGS

Material Description and Classification	Depth (feet)	Elevation	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 2in. Thick.	0								
AGGREGATE BASE (AB), 6in. Thick.									
CLAYEY SAND with Gravel (SC), loose, brown, moist, occasional inclusions of light brown silt. (FILL).		445	4 4 5		14				LL: 37, PI: 23 Sieve Analysis -#200= 28%
SANDY LEAN CLAY (CL), soft, brown, moist, medium plasticity, fine to coarse sand, trace claystone gravel (FILL).	5		2 2 1				2.0		
GRAVEL with Clay and Sand (GW-GC), medium dense, brown, moist, fine gravel to coarse gravel, subangular to angular, occasional inclusions/thin layers of orange brown and light tan well graded Sand (SW).		440	3 14 11		6				Sieve Analysis -#200= 11%
			7 5 5				3.5		
Decrease in sand and gravel content in middle of sample, dark gray to black Fat Clay (CH) in tip of sampler.	10								
LEAN CLAY with Sand (CL), hard, dark brown, moist, medium plasticity.		435	6 15 19				9.0		LL: 43, PI: 32
	15								
FAT CLAY with Sand (CH), stiff, brown, moist, Clayey Sand w/ Gravel (SC) layer in middle of sample, zones of seepage, angular claystone gravel.		430	3 6 5				4.5		bottom PP: 1.5
	20								

Boring Terminated At 29.5 ft BGS

LOG OF BORING B-01
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-1

Surface Elevation: 448.0 ft	Date Drilled: 06/23/09
Drilling Method: CME 75 w/ 8-in HSA	Logged By: Chad Stoehr
Drilling Contractor: S/G Drilling	Checked By: Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	Depth to Groundwater: 16.0 ft BGS

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
		425									
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely to intensely weathered, moderately hard rock, dark olive, very intensely fractured.	25				50/4						
		420									
Moderately weathered rock.					50/3						
Boring terminated at 29.5 ft bgs. Backfilled with cuttings/cold patch, groundwater encountered at 16 ft bgs.	30										
		415									
	35										
		410									
	40										

DRAFT

Boring Terminated At 29.5 ft BGS

LOG OF BORING B-01
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-1

Surface Elevation: 447.5 ft	**Date Drilled:** 06/22/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 15.0 ft BGS

Material Description and Classification	Depth (feet) / Elevation	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4in. Thick.	0							
CLAYEY SAND with Gravel (SC), medium dense, olive gray, moist, fine sand to coarse sand, angular and subangular fine gravel (FILL).	445	3 7 8						Sieve Analysis -#200= 37%
CLAYEY SAND (SC), dense, olive gray, moist, fine sand to coarse sand, trace subangular and angular claystone gravel up to approx. 1.5 in.	5	7 18 22	128	10		8.5		EI: 35
Loose to med dense, increase in gravel content angular, iron ixide staining, occasional gray mottling.	440	2 3 5				4.5		Sieve Analysis -#200= 33%
Dense, decrease in gravel content, angular claystone fragment in tip of sampler greater than 2.5 in.	10	5 8 20						
FAT CLAY with Sand (CH), stiff to very stiff, brown, moist, occasional gray mottling, 3 in of Sandy Fat Clay (CH) in middle of sample.	435 / 15	2 5 7				4.5		
FAT CLAY with Sand (CH), very stiff, brown, moist, occasional gray mottling and iron oxide staining.	430 / 20	6 9 10				5.5		

Boring Terminated At 27.0 ft BGS

LOG OF BORING B-02

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-2

Surface Elevation: 447.5 ft	**Date Drilled:** 06/22/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 15.0 ft BGS

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
		425									
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), moderately weathered, moderately hard to hard rock, olive gray, intensely to very intensely fractured.					50/2						
	25										
					50/1						
Boring terminated at 27 ft bgs. Backfilled with cuttings and cold patch, groundwater encountered at 15 ft bgs.		420									
	30										
		415									
	35										
		410									
	40										

DRAFT

Boring Terminated At 27.0 ft BGS

LOG OF BORING B-02
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-2

Surface Elevation: 448.5 ft	**Date Drilled:** 06/22/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 14.5 ft BGS

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4in. Thick.	0										
FAT CLAY (CH), firm, brown, moist, occasional inclusions of orange brown silt (FILL).		445			3 3 3						
SANDY LEAN CLAY with Gravel (CL), stiff, brown, moist, medium plasticity, approx. 2in. angular claystone gravel in tip of sampler, olive brown (FILL).	5				3 5 10		21				LL: 50, PI: 35 Sieve Analysis -#200= 58%
Hard, decrease in gravel content, difficult drilling noted by driller.		440			42 22 4						Sieve Analysis -#200= 42%
Stiff, easier drilling noted by driller. Pieces of concrete in cuttings.	10				5 6 7	102	24				
SANDY FAT CLAY (CH), very stiff, olive, moist, fine sand, occasional organics (roots), organic odor, occasional angular claystone fragments.	15	435			3 5 8				5.0		EI: 108
		430			2 4 7				4.0		
FAT CLAY (CH), stiff, brown, moist, iron oxide staining throughout, occasional grey mottleing, subangular fine gravel Clayey Dand (SC) layer on top of clay.	20										
Boring terminated at 20.5 ft bgs. Backfilled with cuttings/cold patch, groundwater encountered at 14.5 ft bgs.		425									

DRAFT

Boring Terminated At 20.5 ft BGS

LOG OF BORING B-03

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-3

LOG OF BORING 1766.005.GPI.GPJ ESPANA GEOTECH.GDT 3/7/09

Surface Elevation: 447.5 ft	Date Drilled: 06/22/09
Drilling Method: CME 75 w/ 8-in HSA	Logged By: Chad Stoehr
Drilling Contractor: S/G Drilling	Checked By: Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	Depth to Groundwater: Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
SANDY LEAN CLAY (CL), stiff, dark brown, moist, medium plasticity, occasional inclusions of orange silt (FILL).	0	445			5 7 8		16				LL: 33, PI: 18
SANDY FAT CLAY with Gravel (CH), stiff to very stiff, red brown, moist, iron oxide staining throughout, angular claystone fragments up to approx. 1 in.	5				2 4 8				4.0		EI: 105
FRANCISCAN FORMATION (KJf), Claystone (Rx), Fat Clay (CH), very intensely weathered to decomposed, soft to moderately soft rock, red brown, very intensely fractured, frequent iron oxide staining.	10	440			50/4 28 23 26						
Very intensely weathered, difficult to discern bedding.		435			50/5.5						
Boring terminated at 14.5 ft bgs . Backfilled with cuttings, groundwater not encountered.	15	430									
	20										

Boring Terminated At 14.5 ft BGS

LOG OF BORING B-04

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-4

Surface Elevation: 447.0 ft	**Date Drilled:** 06/23/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 14.0 ft BGS

Material Description and Classification	Depth (feet) / Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4in. Thick.	0									
SANDY FAT CLAY with Gravel (CH), very stiff, gray brown, moist, angular fine to coarse claystone gravel (FILL).	445			5 6						
GRAVELLY FAT CLAY (CH), stiff, brown, moist, angular fine to coarse gravel, pieces of rubber in cuttings (FILL).	5			18 9 7 6		7				
CLAYEY SAND with Gravel (SC), medium dense, brown, moist, fine sand to coarse sand, inclusions of orange-brown sand and silt, encountered hard material at 9 ft: hammer bouncing (refusal), pull out and moved hole 10 ft south.	440			2 3 10				2.5		
Loose, iron oxide staining, occasional angular fine to coarse gravel.	10			4 5 4						
	435									
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely weathered to decomposed, very soft to soft rock, olive brown, iron oxide staining throughout, very intensely fractured, chalky white stringers.	15			50/3						
	430									
Refusal to drilling.	20									
Boring terminated at 20 ft bgs due to refusal to drilling. Backfilled with cuttings/cold patch, groundwater encountered at 14 ft bgs.	425									

Boring Terminated At 20.0 ft BGS

LOG OF BORING B-05

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-5

Surface Elevation: 447.0 ft	**Date Drilled:** 06/24/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 13.0 ft BGS

Material Description and Classification	Depth (feet) / Elevation	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4in. Thick.	0							
CLAYEY SAND with Gravel (SC), very dense, brown, moist, fine sand to coarse sand, angular fine to coarse gravel (FILL).								
	445							
Choppy drilling.		5 4 50/3	114	14	2.1	4.5		Sieve Analysis -#200= 29%
Hard claystone fragment retrieved.		50/1						
Encountered refusal to drilling, possibly concrete, cobble/boulder in fill.	5							
Moved boring location 10 ft to the southwest.								
	440							
CLAYEY SAND with Gravel (SC), medium dense, red brown, moist, fine sand to coarse sand, angular fine to coarse claystone gravel, occasional inclusions of orange silt and sand (FILL).		9 9 8	110	12				Sieve Analysis -#200= 17%
	10							
	435							
SANDY FAT CLAY (CH), very stiff, dark brown, moist, occasional subangular and subrounded fine gravel, occasional gray inclusions.				▼				
		4 7 11				7.0		
	15							
	430							
Subrounded fine gravel, occasional iron oxide staining.		7 13 16				8.5		
	20							

Boring Terminated At 30.0 ft BGS

LOG OF BORING B-06
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-6

Surface Elevation: 447.0 ft	**Date Drilled:** 06/24/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 13.0 ft BGS

Material Description and Classification	Depth (feet) Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
	425									
FAT CLAY with Sand (CH), very stiff, dark brown, moist. Angular claystone fragments in tip of sampler, difficult drilling.	25			2 5 11				5.5		
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), intensely to moderately weathered, moderately soft to moderately hard rock, olive gray, intensely fractured.	420			45 50/1						
Boring terminated at 30 ft bgs. Backfilled with cuttings/cold patch, groundwater encountered at 13 ft bgs.	30 415 35 410 40									

DRAFT

Boring Terminated At 30.0 ft BGS

LOG OF BORING B-06
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-6

Surface Elevation: 445.0 ft	**Date Drilled:** 06/23/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4in. Thick.	0	445							
AGGREGATE BASE (AB), 6 in. Thick.									
GRAVEL with Clay and Sand (GP-GC), medium dense, brown, moist, occasional subangular fine gravel (FILL).			5 5						Sieve Analysis -#200= 12%
GRAVELLY FAT CLAY with Sand (CH), very stiff, olive brown, moist, subangular and angular fine to coarse claystone gravel, inclusions of red brown sand.	5	440	4 9 13 14	139	8				
Drill rig chatter (likely gravel).									
FAT CLAY (CH), stiff, dark brown, moist, occasional iron oxide veins.			5 3 4				3.5		EI: 102
Stiff.	10	435	4 8 11	107	24		7.0		
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), moderately to slightly weathered, moderately hard to hard rock, olive.			50/2						
Boring terminated at 14.5 ft bgs. Backfilled with cuttings/cold patch, groundwater was not encountered.	15	430							
	20	425							

Boring Terminated At 14.5 ft BGS

LOG OF BORING B-07
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-7

Surface Elevation: 445.5 ft	**Date Drilled:** 06/23/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4in. Thick.	0	445							
FAT CLAY with Sand (CH), stiff to very stiff, brown, moist, (FILL).			3 5 7				8.0		Sieve Analysis -#200= 79%
			4 7 12		22		5.0		LL: 54, PI: 40
	5	440							
FAT CLAY (CH), stiff, dark brown, moist, occasional iron oxide staining (FILL).									
CLAYEY SAND with Gravel (SC), dense, brown, (decomposed Franciscan Formation).			19 19 25				9.0		
FRANCISCAN FORMAION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely weathered to decomposed, soft rock, red brown, very intensely fractured, iron oxide staining throughout, very intensely weathered, chalkey white stringers.			14 35 50/2	121	14	7.5			
	10	435							
Olive brown, moderately soft to moderately hard, very intensely weathered.			50/4						
	15	430							
Boring terminated at 14.5 ft bgs. Backfilled with cuttings/cold patch, groundwater not encountered.									
	20	425							

Boring Terminated At 14.5 ft BGS

LOG OF BORING B-08

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-8

Surface Elevation: 446.0 ft	Date Drilled: 06/22/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 3 in. Thick.	0										
AGGREGATE BASE (AB), 7 in. Thick.											
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely weathered to decomposed, moderately soft rock, red brown, very intensely fractured, iron oxide staining throughout.		445			50/5						
					16 33 30						
Occasional chalkey white stringers.	5	440									
Intensely weathered, moderately soft to moderately hard rock.					50/4						
	10	435									
Intensely weathered, olive brown, decrease in iron oxide staining.					23 50/3						
Boring terminated at 15 ft bgs. Backfilled with cuttings/cold patch, groundwater not encountered.	15	430									
	20										

DRAFT

Boring Terminated At 15.0 ft BGS

LOG OF BORING B-09
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-9

Surface Elevation: 445.0 ft	**Date Drilled:** 06/23/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 3 in. Thick.	0	445									
AGGREGATE BASE (AB), 8 in. Thick.											
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), decomposed to very intensely weathered, moderately soft rock, red brown and light tan, iron oxide staining throughout.					23 41 50/4	120	14	12.7			LL: 37, PI: 20 Sieve Analysis -#200= 86%
Occasional white crystalline stringers.					14 21 22						
	5	440									
Hard slightly weathered, massive sandstone fragment in tip of sampler.					21 50/4	124	9				
					2 50/3						
	10	435									
					50/1						
Boring terminated at 11 ft bgs. Backfilled with cuttings/cold patch, groundwater not encountered.											
	15	430									
	20	425									

Boring Terminated At 11.0 ft BGS

LOG OF BORING B-10
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-10

Surface Elevation: 443.5 ft	**Date Drilled:** 06/22/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 24.0 ft BGS

Material Description and Classification	Depth (feet)	Elevation	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4in. Thick.	0								
CLAYEY SAND (SC), medium dense, brown, moist, fine sand to coarse sand, trace angular fine to coarse claystone gravel, occasional inclusions of orange silt (FILL).		440	4 6 8						Sieve Analysis -#200= 46%
CLAYEY SAND with Gravel (SC), medium dense, brown, moist, fine sand to coarse sand, subangular to angular fine claystone gravel, iron oxide staining throughout (FILL).	5		9 13 15		13				LL: 36, PI: 19 Sieve Analysis -#200= 22%
FAT CLAY (CH), firm to stiff, dark brown, moist.		435	3 3 4				6.0		
Very stiff.	10		4 8 10	100	24	5.1	5.5		
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely weathered to decomposed, very soft to soft rock, light olive, very intensely fractured, iron oxide staining throughout, occasional chalky white crystalline veins.	15	430	8 21 36						
Intensely weathered, moderately soft to moderately hard, olive brown.	20	425	50/4						

DRAFT

Boring Terminated At 24.5 ft BGS

LOG OF BORING B-11
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-11

Surface Elevation: 443.5 ft	**Date Drilled:** 06/22/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** 24.0 ft BGS

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
		420									
					50/6						
Boring terminated at 24.5 ft bgs. Backfilled with cuttings/cold patch, groundwater encountered at 24 ft bgs.	25										
		415									
	30										
		410									
	35										
		405									
	40										

DRAFT

Boring Terminated At 24.5 ft BGS

LOG OF BORING B-11
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-11

LOG OF BORING 1766.005.GPJ.GPJ ESPANA GEOTECH.GDT 8/7/09

Surface Elevation: 441.5 ft	**Date Drilled:** 06/24/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
SILT (ML), stiff, light brown, moist, topsoil.	0										
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely weathered, moderately soft to moderately hard rock, olive brown, very intensely fractured.		440									
					4				5.0		
					44						
					47						
Intensely weathered, moderately hard.					50/5		8				Sieve Analysis -#200= 26%
	5										
Squealing augers.		435									
Very difficult drilling noted by driller.											
Intensely weathered.					30						
Refusal to drilling.					50/4						
	10										
Boring terminated at 10 ft bgs due to refusal to drilling. Backfilled with cuttings, groundwater not encountered.		430									
	15	425									
	20										

Boring Terminated At 10.0 ft BGS

LOG OF BORING B-12
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-12

Surface Elevation: 471.0 ft	**Date Drilled:** 06/25/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
FAT CLAY (CH), dark brown, dry to moist, occasional roots.	0	470									
FRANCISCAN FORMATION (KJf), Claystone (RX) & Fat Clay (CH), decomposed to very intensely weathered, very soft rock, olive brown, very intensely fractured, occasional chalky white inclusions.					6 9 13						
Soft rock.	5	465			19 35 46	133	4				LL: 36, PI: 22 Sieve Analysis -#200= 65%
Olive gray.	10	460			21 30 30						
Moderately weathered, moderately hard rock, intensely fractured.					50/2						
Boring terminated at 14.5 ft bgs. Backfilled with cuttings, groundwater not encountered.	15	455									
	20										

DRAFT

Boring Terminated At 14.5 ft BGS

LOG OF BORING B-13

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-13

Surface Elevation: 474.0 ft	**Date Drilled:** 06/24/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
FAT CLAY (CH), very stiff, dark brown, moist.	0										
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), decomposed to very intensely weathered, moderately soft rock, very intensely fractured, olive brown, occasional chalky white inclusions, iron oxide staining.					12 16 28	115	16		9.0		LL: 52, PI: 38
		470			14 24						
Intensely weathered.	5				50/4						
		465			50/5						
Olive gray, approximately 1 in inclusion of light gray sanstone in middle of sample.	10										
Intensely to moderately weathered.		460			24 42 50/3						
	15										
Slightly weathered, dark gray, intensely fractured, moderately hard rock.		455			50/4						
	20										

Boring Terminated At 25.0 ft BGS

DRAFT

LOG OF BORING B-14
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-14

Surface Elevation: 474.0 ft	**Date Drilled:** 06/24/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
		450			28 50/4						
Boring terminated at 25 ft bgs. Backfilled with cuttings, groundwater not encountered.	25										
		445									
	30										
		440									
	35										
		435									
	40										

Boring Terminated At 25.0 ft BGS

LOG OF BORING B-14
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-14

LOG OF BORING 1766.005.GPJ.GPJ ESPANA GEOTECH.GDT 8/7/09

Surface Elevation: 480.0 ft	**Date Drilled:** 06/24/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
FAT CLAY (CH), light brown, dry to moist.	0	480									
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely weathered, moderately soft to moderately hard rock, olive brown, very intensely fractured, iron oxide staining.					17 40 50/5						
Intensely to moderately weathered, moderately hard rock, intensely fractured.					50/5						
	5	475									
					50/3						
	10	470									
Moderately weathered.					50/<1						
	15	465									
Intensely to moderately weathered, very intensely fractured, shear zone in middle of sample, red clay filled fractures, wet (seepage) in fractures.					10 50/2						
	20	460									
Boring terminated at 19 ft bgs. Backfilled with cuttings, groundwater not encountered.											

DRAFT

Boring Terminated At 19.0 ft BGS

LOG OF BORING B-15
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-15

Surface Elevation: 435.0 ft	Date Drilled: 06/25/09
Drilling Method: CME 75 w/ 8-in HSA	Logged By: Chad Stoehr
Drilling Contractor: S/G Drilling	Checked By: Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	Depth to Groundwater: Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
SANDY FAT CLAY (CH), stiff, brown, moist, Clayey Sand (SC) layer with gravel in bottom of sampler, pieces of glass, occasional angular fine to coarse claystone fragments up to approx. 1.5 in. (FILL).	0	435			3 5						
CLAYEY SAND with Gravel (SC), very dense, gray brown, moist, angular fine to coarse shale and claystone gravel, pieces of metal/nails in cuttings, refusal to drilling (FILL).	5	430			5 15 50/4	96	15				Sieve Analysis -#200= 20%
Boring terminated at 5.5 ft bgs due to refusal to drilling. Backfilled with cuttings, groundwater not encountered.											
	10	425									
	15	420									
	20	415									

Boring Terminated At 5.5 ft BGS

LOG OF BORING B-16
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-16

Surface Elevation: 437.5 ft	**Date Drilled:** 06/25/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
FAT CLAY with Gravel (CH), stiff, brown, moist, angular fine to coarse gravel (FILL).	0										
CLAYEY SAND with Gravel (SC), medium dense, dark brown, moist, fine sand to coarse sand.		435			7 9 8		10		8.5		LL: 39, PI: 25 Sieve Analysis -#200= 23%
					3 10 26						
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), decomposed to very intensely weathered, very soft rock, red brown, very intensely fractured, iron oxide staining throughout.	5										
		430			12 16 28						
Olive brown.	10				14 24 20						
Boring terminated at 10.5 ft bgs. Backfilled with cuttings, groundwater not encountered.		425									
	15										
		420									
	20										

Boring Terminated At 10.5 ft BGS

LOG OF BORING B-17
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-17

Surface Elevation: 429.0 ft	Date Drilled: 06/25/09
Drilling Method: CME 75 w/ 8-in HSA	Logged By: Chad Stoehr
Drilling Contractor: S/G Drilling	Checked By: Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	Depth to Groundwater: Not Encountered

Material Description and Classification	Depth (feet) Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
CLAYEY SAND (SC), very dense, red brown, moist, fine sand to coarse sand, trace angular fine to coarse claystone gravel.	0									
				15 19				6.5		Sieve Analysis -#200= 21%
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay (CH), very intensely weathered, very soft to soft rock, red brown, very intensely fractured, iron oxide staining throughout.	425 5			24 26 50/6						
				14 21 32						
Boring terminated at 8.5 ft bgs. Backfilled with cuttings groundwater not encountered.	420 10									
	415 15									
	410 20									

DRAFT

Boring Terminated At 8.5 ft BGS

LOG OF BORING B-18
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-18

Surface Elevation: 450.5 ft	**Date Drilled:** 06/25/09
Drilling Method: CME 75 w/ 8-in HSA	**Logged By:** Chad Stoehr
Drilling Contractor: S/G Drilling	**Checked By:** Michael Hughes
Hammer: 140 lb. auto hammer with 30-in. drop	**Depth to Groundwater:** Not Encountered

Material Description and Classification	Depth (feet)	Elevation	Soil Type	Sample Type	Field Blows	Dry Density (pcf)	Moisture Content (%)	Unc. Comp. Strength (ksf)	Pocket Pen. (ksf)	Torvane (ksf)	Remarks and Other Lab Tests
ASPHALTIC CONCRETE (AC), 4 in. Thick.	0	450									
AGGREGATE BASE (AB), 7 in. Thick.											
CLAYEY SAND with Gravel (SC), dense, brown, moist, fine sand to coarse sand, iron oxide staining, angular fine to coarse claystone gravel (FILL).					11 18 29	121	12	6.6			LL: 334, PI: 18 Sieve Analysis -#200= 20%
					7 9 10	124	13		6.0		
	5	445									
Difficulty drilling (possible cobbles/boulders).											
FAT CLAY (CH), firm to stiff, dark gray, moist, slight organic odor (FILL).					5 4 4				5.0		
					9 28 50/2.5				9.0		
FRANCISCAN FORMATION (KJf), Claystone (Rx) & Fat Clay, very intensely weathered, soft rock, red brown, very intensely fractured, dark gray clay filled fractures.	10	440									
Occasional light gray stringers and inclusions.					22 45 45				8.0		
	15	435									
Moderately soft, moist to wet sand seem in middle of sampler, hard slightly weathered, olive sandstone fragment in tip of sampler approx. 2 in.					47 50/1						
	20	430									
Boring terminated at 20 ft bgs. Backfilled with cuttings/cold patch, groundwater not encountered.											

Boring Terminated At 20.0 ft BGS

LOG OF BORING B-19

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-19

LOG OF BORING 1766.005.GPJ.GPJ ESPANA GEOTECH.GDT 8/7/09

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		grf	ltr	Description
Coarse Grained Soils	Gravel And Gravelly Soils		GW	Well-graded gravels or gravel sand mixtures, little or no fines
			GP	Poorly-graded gravels or gravel sand mixture, little or no fines
			GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sand And Sandy Soils		SW	Well-graded sands or gravelly sands, little or no fines
			SP	Poorly-graded sands or gravelly sands, little or no fines
			SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, and-clay mixtures

Major Divisions		grf	ltr	Description
Fine Grained Soils	Silts And Clays LL < 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts or clays of low plasticity
	Silts And Clays LL > 50		MH	Inorganic silts, micaceous or diatomaceous fine or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic silts or clays of medium to high plasticity
Highly Organic Soils			PT	Peat and other highly organic soils

GRAIN SIZES

U.S. STANDARD SERIES SIEVE: 200, 40, 10, 4 — CLEAR SQUARE SIEVE OPENINGS: 3/4", 3", 12"

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

RELATIVE DENSITY

Sands and Gravels	Blows/Foot*
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50

CONSISTENCY

Silts and Clays	Blows/Foot*	Strength (Ksf)**
Very Soft	0 - 1	0 - 1/2
Soft	2 - 4	1/2 - 1
Firm	5 - 8	1 - 2
Stiff	9 - 15	2 - 4
Very Stiff	16 - 30	4 - 8
Hard	Over 31	Over 8

DRAFT

*Number of Blows for a 140-pound safety hammer falling 30 inches, driving a 2-inch O.D. (1-3/8" I.D.) split spoon sampler.

**Unconfined compressive strength.

SYMBOLS

- Standard Penetration sample (1-3/8" ID)
- Modified California sample (2.5" ID)
- California sample (2" ID)
- Shelby Tube sample
- Acetate Sleeve (1-1/2" ID)
- Bulk Sample from Cuttings
- Groundwater Level During Drilling
- Stabilized Groundwater Level

Notes

bgs Below Ground Surface
bbd Below Barge Deck
MDD Maximum Dry Density
OMC Optimum Moisture Content
c cohesion
psf pounds per square foot
pcf pounds per cubic foot
LL Liquid Limit
PI Plasticity Index
-200 Passing the #200 Sieve
CGI Combustible Gas Indicator
VOC Volatile Organic Compound
CO Carbon Monoxide
LEL Lower Explosive Limit
H_2S Hydrogen Sulfide
ppm parts per million

TV Torvane Shear Test
PP Pocket Penetrometer
AC Asphalt Concrete
AB Aggregate Base
PCC Portland Cement Concrete

Increasing Visual Moisture Designation

Dry
Moist
Wet

BORING LEGEND

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate A-20

WEATHERING*

FRESH - Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer blows if crystalline.
SLIGHTLY WEATHERED TO FRESH - Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rings under hammer blows if crystalline.
SLIGHTLY WEATHERED - Rock generally fresh, joints stained, and discoloration extends into rock up to 1 inch. Joints may contain clay. In granitiod rocks, occasional feldspar crystals are dull & discolored. Crystalline rock rings under hammer blows.
MODERATELY WEATHERED - Significant portions of rock show discoloration and weathering effects. In granitiod rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
INTENSELY TO MODERATELY WEATHERED - All rock except quartz discolored or stained. In granitiod rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick. Rock goes "clunk" when struck.
INTENSELY WEATHERED - All rock except quartz discolored/stained. Rock "fabric" clear & evident, but reduced in strength to strong soil. In some granitiod rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually remain.
VERY INTENSELY WEATHERED - All rock except quartz discolored or stained. Rock "fabric" discernible, but rock mass effectively reduced to "soil" with only fragments of strong rock remaining.
DECOMPOSED - Rock reduced to "soil." Rock "fabric" not discernible or discernible only in small scattered locations. Quartz may be present as dikes or stringers.

STRENGTH

VERY STRONG - Resists breakage from hammer blows; but will yield dust and small chips.
STRONG - Withstands a few hammer blows; but will yield large fragments.
MODERATELY STRONG - Withstands a few firm hammer blows.
WEAK - Crumbles with light hammer blows.
FRIABLE - Can be broken down with hand and finger pressure.

DISCONTINUITY SPACING

JOINTS	BEDDING, CLEAVAGE, FOLIATION	ENGLISH	METRIC
VERY CLOSE	Very Thin	Less than 2 inches	Less than 5 cm
CLOSE	Thin	2 inches to 1 foot	5 cm to 30 cm
MODERATELY CLOSE	Medium	1 foot to 3 feet	30 cm to 1 m
WIDE	Thick	3 feet to 10 feet	1 m to 3 m
VERY WIDE	Very Thick	Greater than 10 feet	Greater than 3 m

HARDNESS

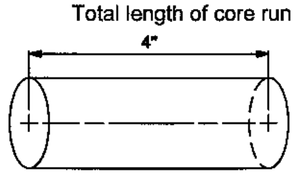
VERY HARD - Cannot be scratched with a knife; metal powder left on sample.
HARD - Scratched with knife with difficulty; trace of metal powder left on samples; scratch faintly visible.
MODERATELY HARD - Readily scratched with knife, scratch leaves heavy trace of dust and is readily visible.
LOW HARDNESS - Gouged or grooved to 1/16 inch by firm pressure on knife; scratches with penny.
SOFT - Gouged or grooved readily with a knife; small thin pieces can be grooved by finger pressure.
VERY SOFT - Carves with knife; scratched by fingernail.

ROUGHNESS OF JOINT OR DISCONTINUITY SURFACES

SMOOTH - Appears smooth and is essentially smooth to the touch. May be slickensided.
SLIGHTLY ROUGH - Asperities on the fracture are clearly visible.
MEDIUM ROUGH - Asperities are clearly visible and fracture surface feels abrasive.
ROUGH - Large angular asperities can be seen. Some ridge and high side angle steps are evident.
VERY ROUGH - Near vertical steps and ridges occur on the fracture surface.

ROCK QUALITY DESIGNATION (RQD)

$$RQD\ (\%) = \frac{\text{Sum of length of solid core pieces 4" or greater}}{\text{Total length of core run}} \times 100$$



SYMBOLS

ROCK

Dolomoite
Igneous
Lignite
Limestone
Sandstone
Shale
Metasediments, Metamorphics, Metavolcanics
Volcanics

SAMPLER

Rock Core Bit

* After GSA Engineering Geology Division Data Sheet 1, 1980.

APPENDIX B

LABORATORY TESTING

LABORATORY TESTING

Samples obtained from the field exploration were contained in brass tubes, and bulk sample bags. These samples were delivered to the laboratory for testing. The tests performed on selected samples are described in the following paragraphs. A summary of the main test results is presented on Plate B-1.

Moisture-Density

The dry unit weight and field moisture content are determined for selected undisturbed samples, in accordance with ASTM D-2216 and ASTM D-2937. The results are shown on the boring logs, as well as on Plate B-1.

Laboratory Soil Classification

The field classification is verified in the laboratory by visual examination and by ASTM methods in accordance with the Unified Soil Classification System. The classification tests utilized during this investigation were Atterberg Limits (ASTM D4318) and sieve analysis (ASTM C136). The Atterberg Limits and sieve analysis test results are presented in Plates B-2 through B-6.

Corrosivity Tests

Selected samples were tested for redox, pH, resistivity, sulfate, and chlorides. The tests were performed using ASTM Methods D1498, D4972, G57 and D4327 respectively. Test results are shown in Table B-1.

Unconfined Compressive Strength

The unconfined compressive strength (ASTM D2166) provides an approximation of the compressive strength of a cohesive soil in terms of total stresses. The soil sample is placed in a compression device and the load is increased and recorded until the load values decrease with increasing strain or until 15 percent strain is reached. The unconfined compressive strength results are presented in Plates B-7 and B-8.

Maximum Density-Optimum Moisture Content

Representative soil samples were tested in the laboratory to determine the maximum dry density and optimum moisture content using ASTM D1557 compaction test method. This procedure uses 25 blows of a 10-pound hammer falling a height of 18 inches on each of five layers in a 1/30 cubic foot cylinder. Test results are shown on Plate B-9.

Expansion Index

Remolded, representative samples were tested for their Expansion Index in accordance with ASTM D4829. During the Expansion Index test, the sample is compacted into a metal ring so that the degree of saturation is between 40 and 60 percent. The sample is loaded with a surcharge of 144 psf and saturated for a period of 24 hours, at which time the deformation is recorded. The test results are shown in Table B-2.

R-Value

Three R-Value tests were performed on selected bulk samples to determine the R-Value for pavement design. The test was run in accordance with Caltrans Test 301. The test results are shown below in Table B-3.

Table B-1 – Summary of Chemical Tests Results

Boring No.	Depth (feet)	Resistivity (ohm-cm)	pH	Chloride (ppm)	Sulfate (ppm)
B-1	4.0	850	8.0	N.D.	110
B-5	2.5	680	7.8	N.D.	1100
B-10	4.0	1600	8.3	N.D.	N.D.
B-11	7.0	780	7.4	16	48
B-13	2.5	1000	8.3	49	86
B-16	2.5	1900	8.2	N.D.	27
B-19	4.0	1400	8.2	N.D.	120

Note: (ppm) parts per million

Table B-2 – Summary of Expansion Index Test Results

Boring No.	Depth (feet)	R-Value
B-2	4	35
B-3	14	108
B-4	4	105
B-7	7	102

Table B-3 – Summary of R-Value Test Results

Boring No.	Depth (feet)	R-Value
B-2	3-5	4
B-17	5-8	7
B-18	2-5	19

Boring	Depth (feet)	Liquid Limit	Plasticity Index	Maximum Size	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Phi, degrees	Apparent Cohesion (psf)	Unconfined Compressive Strength (psf)
B-01	2.5	37	23	1 in	28	SC	13.8				
B-01	7.0			2 in	11		6.2				
B-01	14.0	43	32								
B-02	2.5			3/4 in	37						
B-02	4.0						9.7	128.4			
B-02	7.0			1 in	33						
B-03	4.0	50	35	3/4 in	58	CH	20.8				
B-03	7.0			3/4 in	42						
B-03	9.0						24.4	101.8			
B-04	2.5	33	18				16.2				
B-05	4.0						7.0				
B-06	2.5			2 in	29		13.8	113.9			2,094
B-06	9.0			1 in	17		12.3	109.6			
B-07	2.5			2 in	12						
B-07	4.0						7.6	139.0			
B-07	9.0						23.5	107.4			
B-08	2.5			3/8 in	79						
B-08	4.0	54	40				22.4				
B-08	9.0						14.3	121.4			7,529
B-10	2.5	37	20		86	CL	13.6	119.8			12,718
B-10	7.0						9.1	123.9			
B-11	2.5			3/4 in	46						
B-11	4.0	36	19	1 in	22	SC	13.2				
B-11	9.0						24.0	100.4			5,100
B-12	4.0			3/8 in	26		8.0				
B-13	4.0	36	22	3/8 in	65	CL	3.6	133.0			
B-14	2.5	52	38				15.5	114.6			
B-16	4.0			1 in	20		15.4	95.7			
B-17	2.5	39	25	3/4 in	23	SC	9.7				
B-18	2.5			3/4 in	21						
B-19	2.5	34	18	3/4 in	20	SC	12.1	121.0			6,604
B-19	9.0						13.2	123.5			

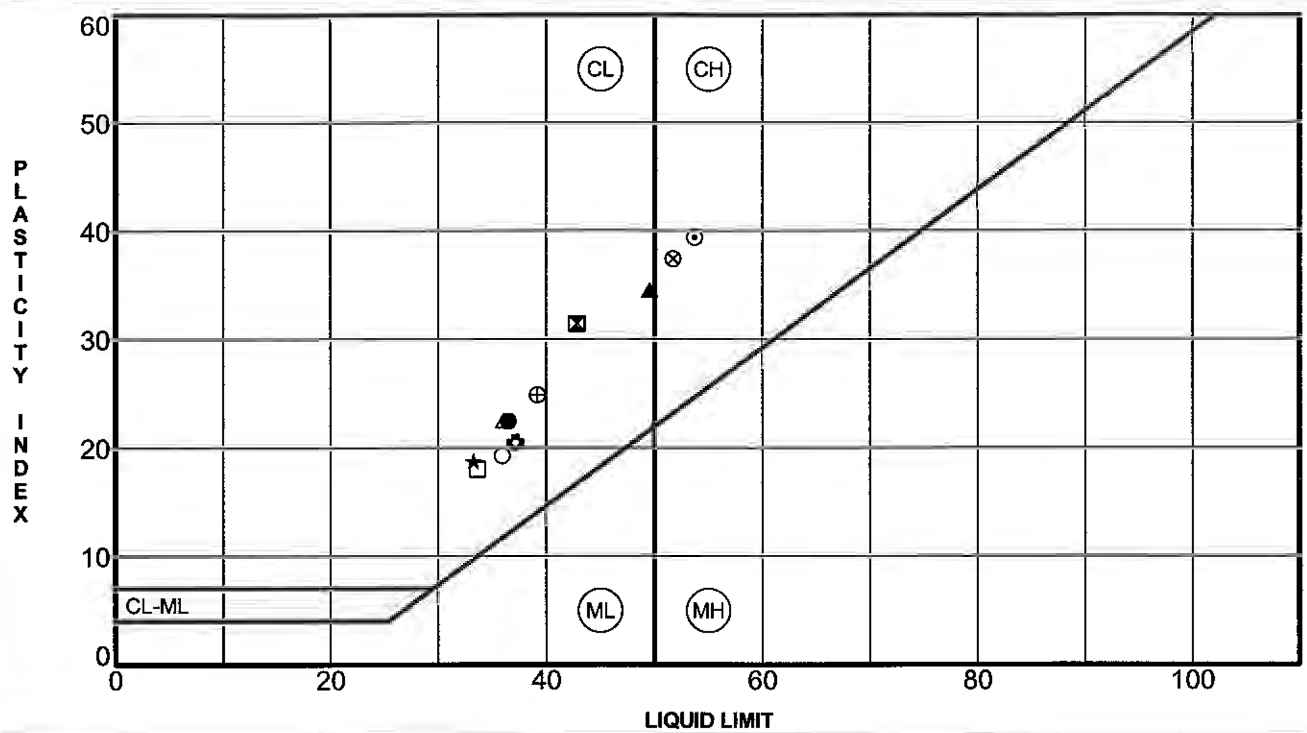
FUGRO LAB SUMMARY 1766-005 V012505.GPJ ESPANA GEOTECH.GDT 8/7/09

SUMMARY OF LABORATORY RESULTS
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-1



Sym	Specimen Identification Sample	Depth (ft)	LL	PL	PI	Fines	Classification
●	B-01	2.5	37	14	23	28	Olive brown clayey SAND with gravel
⊠	B-01	14.0	43	11	32		Very dark grayish brown lean CLAY with sand
▲	B-03	4.0	50	15	35	58	Dark brown sandy lean CLAY with gravel
★	B-04	2.5	33	15	18		Brown sandy lean CLAY
⊙	B-08	4.0	54	14	40		Dark olive gray fat CLAY with sand
✿	B-10	2.5	37	17	20	86	Olive brown lean CLAY
○	B-11	4.0	36	17	19	22	Reddish brown clayey SAND with gravel
△	B-13	4.0	36	14	22	65	Olive sandy lean CLAY
⊗	B-14	2.5	52	14	38		Brown fat CLAY with sand
⊕	B-17	2.5	39	14	25	23	Brown clayey SAND with gravel
□	B-19	2.5	34	16	18	20	Light brown clayey SAND with gravel

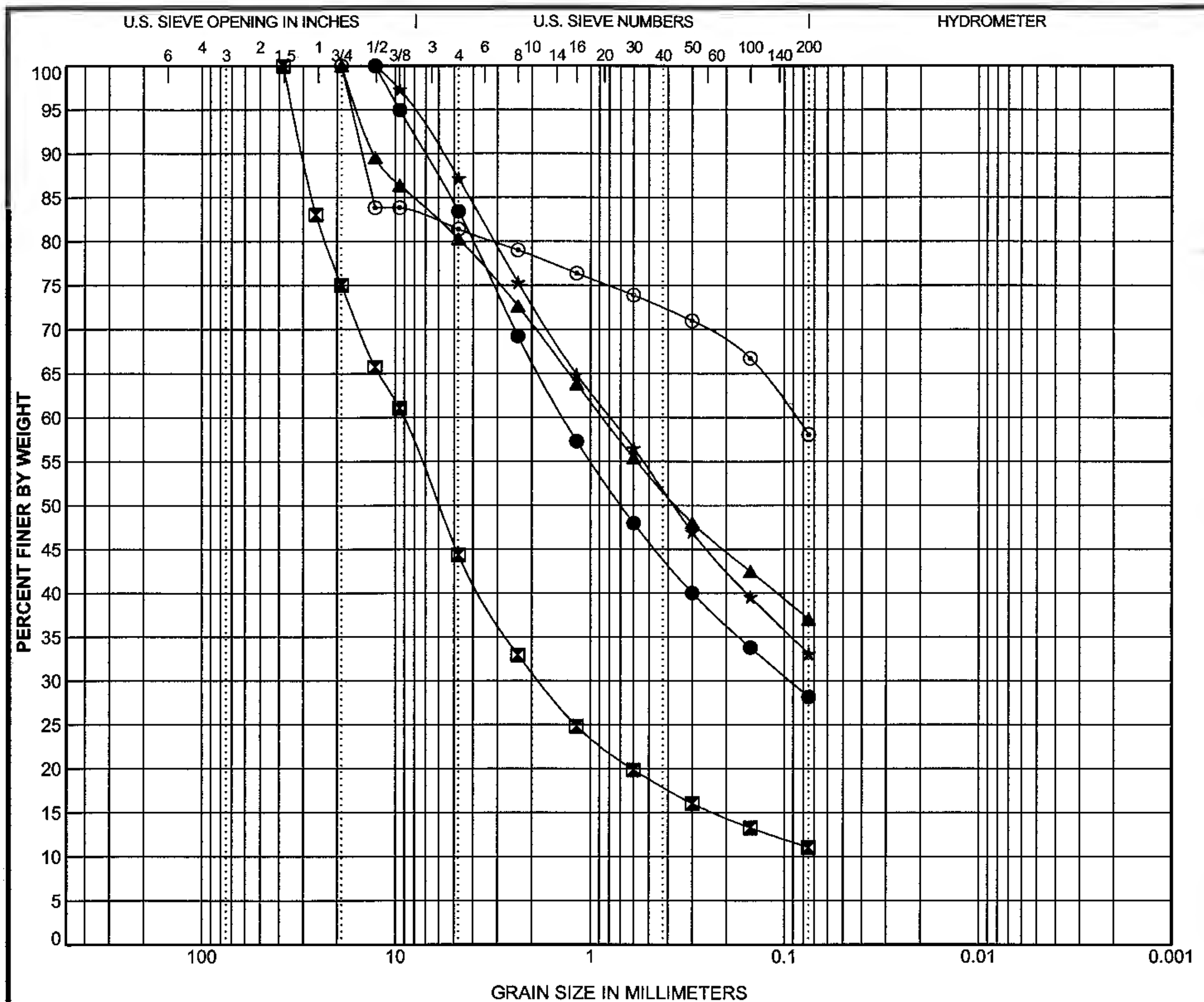
ATTERBERG LIMITS RESULTS

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sym	Specimen Identification Boring	Depth (ft)	Classification	LL	PL	PI	C_c	C_u
●	B-01	2.5	Olive brown clayey SAND with gravel	37	14	23		
⊠	B-01	7.0	Gray brown well-graded GRAVEL with clay and sand				6.81	167.14
▲	B-02	2.5	Olive clayey SAND with gravel					
★	B-02	7.0	Dark olive clayey SAND with trace gravel					
⊙	B-03	4.0	Dark brown sandy lean CLAY with gravel	50	15	35		

Sym	Specimen Identification		D_{100},mm	D_{60},mm	D_{30},mm	D_{10},mm	%Gravel	%Sand	%Silt / %Clay
●	B-01	2.5	12.7	1.382	0.094		16.6	55.2	28.1
⊠	B-01	7.0	38.1	9.096	1.836		55.7	33.3	11.0
▲	B-02	2.5	19	0.869			19.7	43.2	37.0
★	B-02	7.0	12.7	0.796			12.9	54.1	33.1
⊙	B-03	4.0	19	0.088			18.6	23.3	58.0

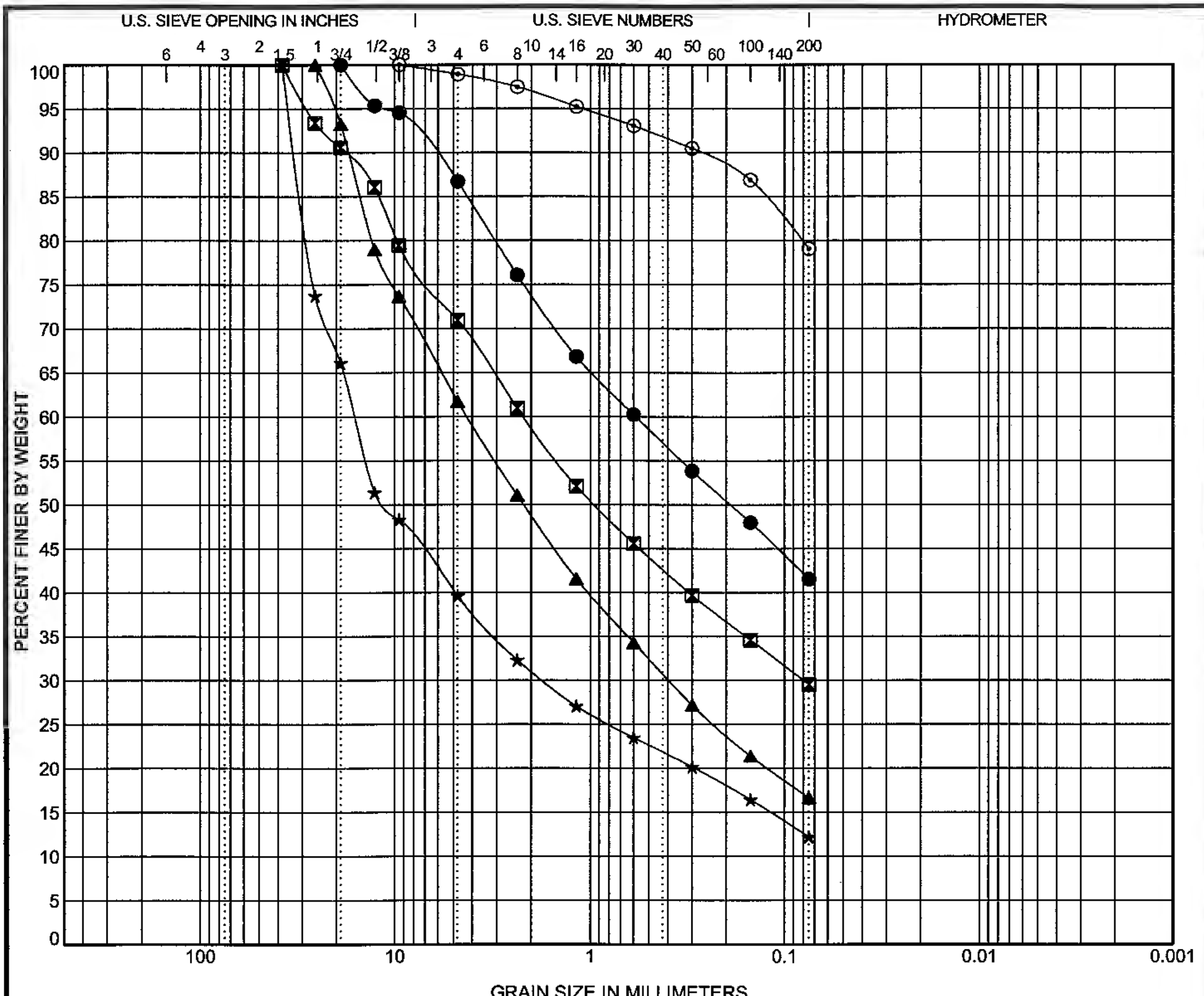
GRAIN SIZE DISTRIBUTION

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-3



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sym	Specimen Identification Boring	Depth (ft)	Classification	LL	PL	PI	C_c	C_u
●	B-03	7.0	Olive brown clayey SAND with trace gravel					
⊠	B-06	2.5	Olive brown clayey SAND with gravel					
▲	B-06	9.0	Reddish brown clayey SAND with gravel					
★	B-07	2.5	Olive brown clayey GRAVEL with sand and clay				3.61	305.71
⊙	B-08	2.5	Dark brown Fat CLAY sand					

Sym	Specimen Identification		D_{100},mm	D_{60},mm	D_{30},mm	D_{10},mm	%Gravel	%Sand	%Silt	%Clay
●	B-03	7.0	19	0.585			13.3	45.2	41.5	
⊠	B-06	2.5	38.1	2.193	0.08		29.0	41.5	29.5	
▲	B-06	9.0	25.7	4.244	0.396		38.3	45.1	16.6	
★	B-07	2.5	38.1	16.071	1.746		60.4	27.4	12.2	
⊙	B-08	2.5	9.5				1.1	19.9	79.0	

GRAIN SIZE DISTRIBUTION

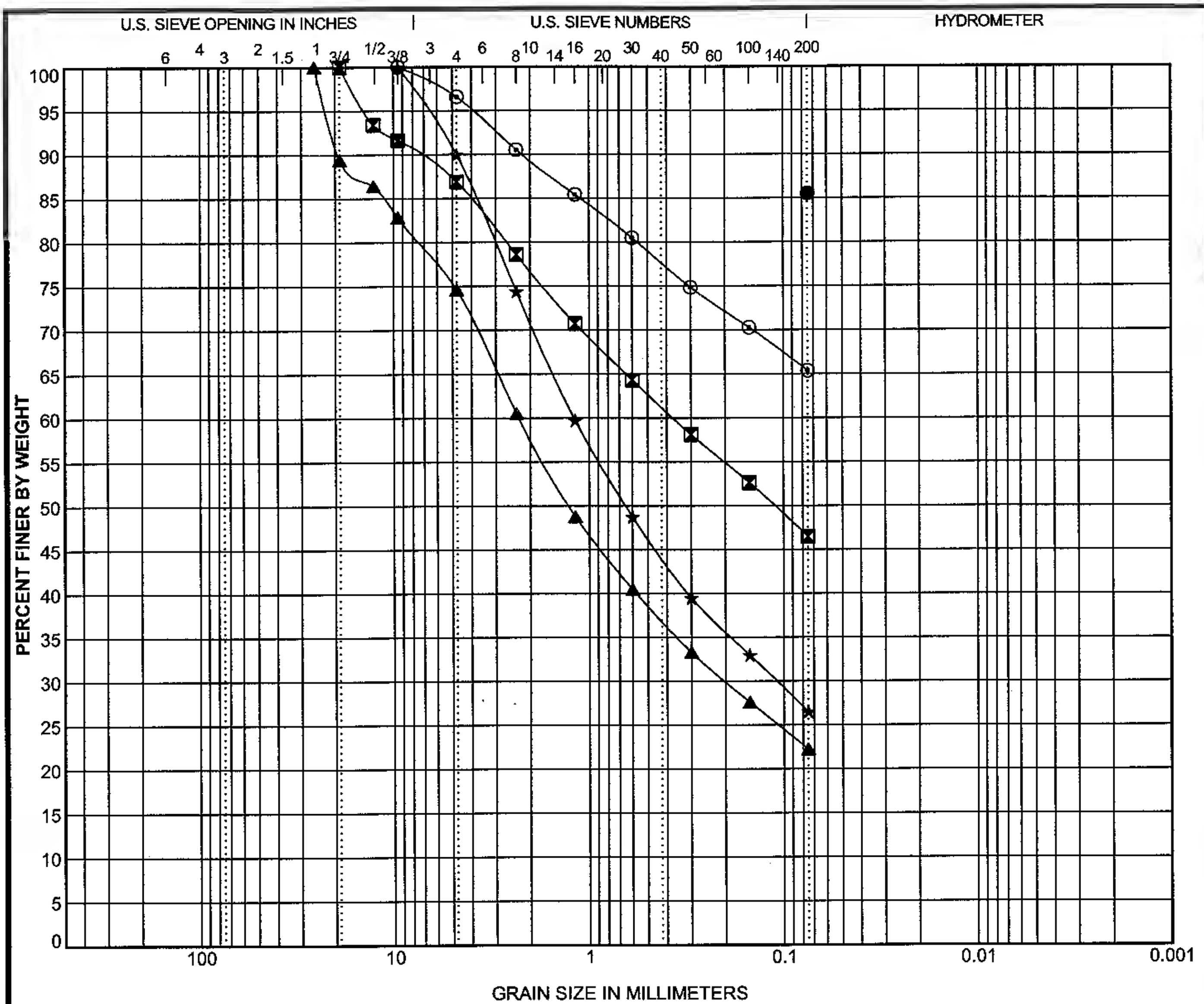
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-4

GRAIN SIZE 1766-005 V012505.GPJ ESPANA GEOTECH.GDT 8/7/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sym	Specimen Identification Boring	Depth (ft)	Classification	LL	PL	PI	C_c	C_u
●	B-10	2.5	Olive brown lean CLAY	37	17	20		
⊠	B-11	2.5	Olive brown clayey SAND with trace gravel					
▲	B-11	4.0	Reddish brown clayey SAND with gravel	36	17	19		
★	B-12	4.0	Gray clayey SAND with trace gravel					
⊙	B-13	4.0	Olive sandy lean CLAY	36	14	22		

Sym	Specimen Identification	Depth (ft)	D_{100},mm	D_{60},mm	D_{30},mm	D_{10},mm	%Gravel	%Sand	%Silt	%Clay
●	B-10	2.5	0.075						85.5	
⊠	B-11	2.5	19	0.37			13.1	40.4	46.5	
▲	B-11	4.0	25.7	2.294	0.202		25.4	52.4	22.2	
★	B-12	4.0	9.5	1.197	0.109		10.0	63.5	26.5	
⊙	B-13	4.0	9.5				3.4	31.2	65.3	

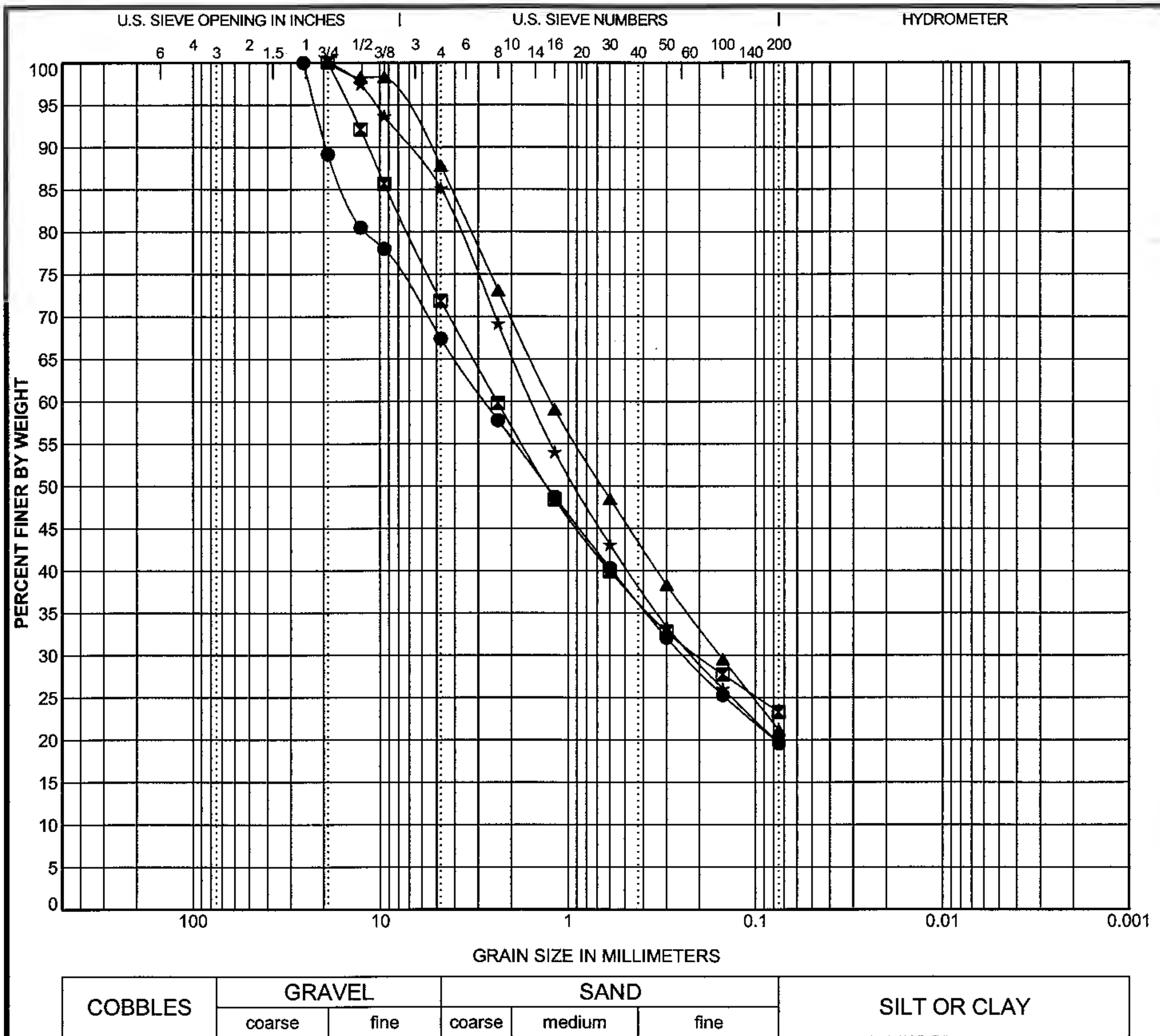
GRAIN SIZE DISTRIBUTION

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-5



Sym	Specimen Identification Boring	Depth (ft)	Classification	LL	PL	PI	C_c	C_u
●	B-16	4.0	Gray brown clayey SAND with gravel					
⊠	B-17	2.5	Brown clayey SAND with gravel	39	14	25		
▲	B-18	2.5	Light olive brown clayey SAND with trace gravel					
★	B-19	2.5	Light brown clayey SAND with gravel	34	16	18		

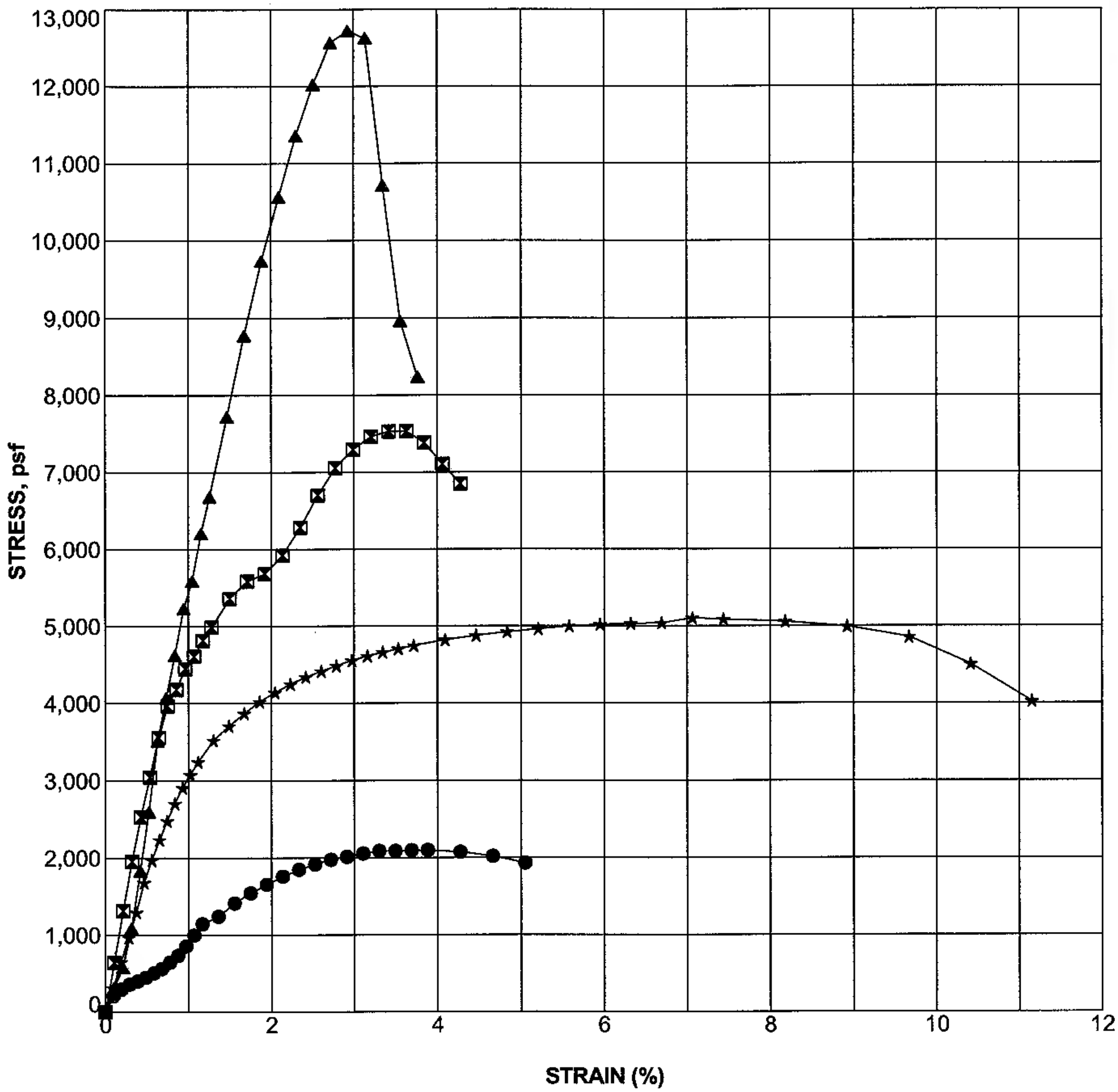
Sym	Specimen Identification		D_{100},mm	D_{60},mm	D_{30},mm	D_{10},mm	%Gravel	%Sand	%Silt	%Clay
●	B-16	4.0	25.7	2.777	0.243		32.6	47.8	19.6	
⊠	B-17	2.5	19	2.392	0.205		28.2	48.6	23.3	
▲	B-18	2.5	19	1.238	0.156		12.2	66.7	21.1	
★	B-19	2.5	19	1.551	0.218		14.9	65.5	19.6	

GRAIN SIZE DISTRIBUTION
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-6



Key Symbol	Boring	Depth (Feet)	Sample Description (USCS)	Dry Density (pcf)	Water Content (%)	Unconfined Strength (psf)	Strain (%)
●	B-06	2.5	Olive brown clayey SAND with gravel	113.9	13.8	2,094	3.9
⊠	B-08	9.0	Light brown sandy lean CLAY	121.4	14.3	7,529	3.4
▲	B-10	2.5	Olive brown lean CLAY	119.8	13.6	12,718	2.9
★	B-11	9.0	Black lean to fat CLAY with sand	100.4	24.0	5,100	7.1

UNCONFINED 1766-005 V012505.GPJ ESPANA GEOTECH.GDT 8/7/09

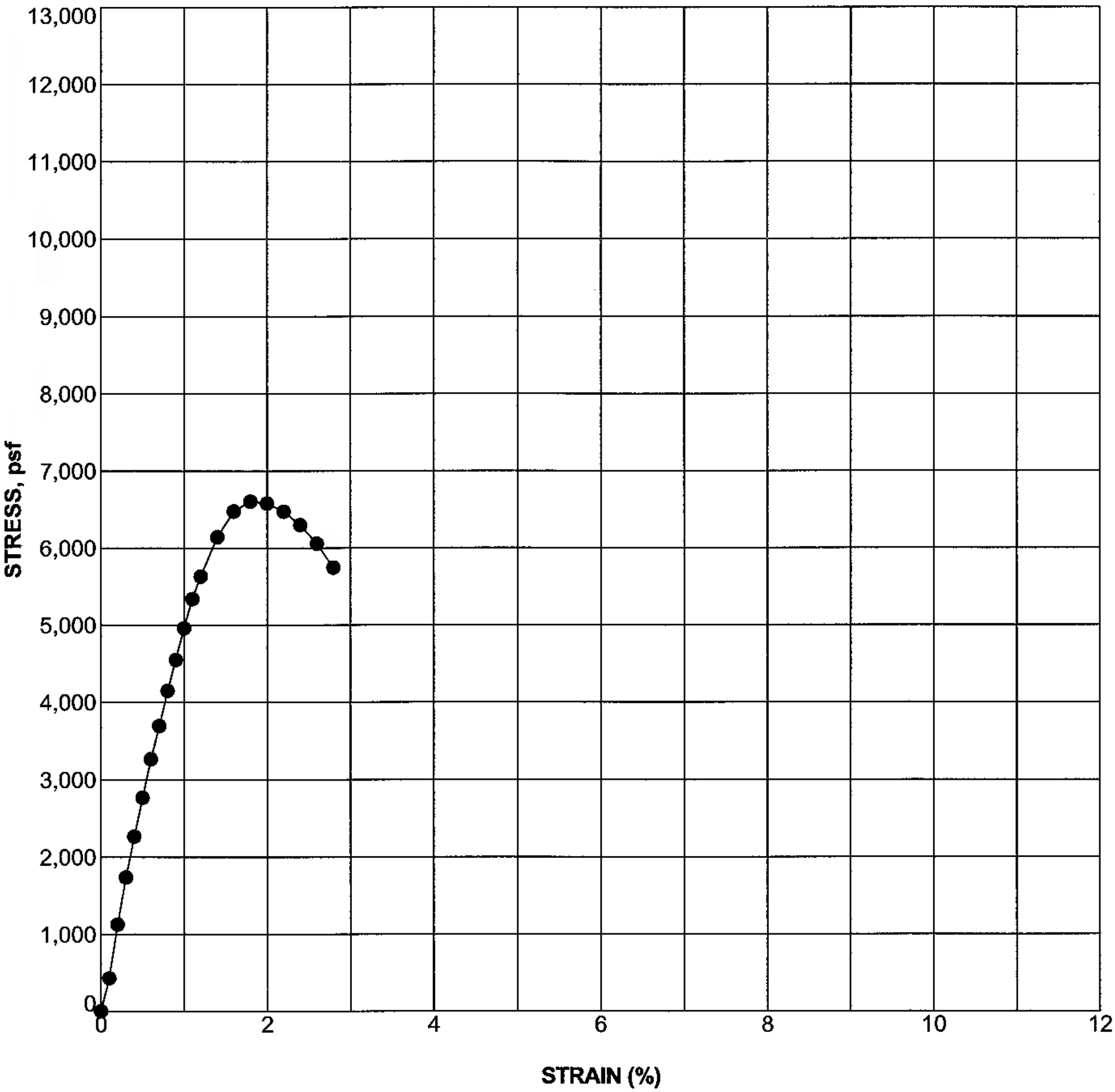
UNCONFINED COMPRESSION TEST

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-7



Key Symbol	Boring	Depth (Feet)	Sample Description (USCS)	Dry Density (pcf)	Water Content (%)	Unconfined Strength (psf)	Strain (%)
●	B-19	2.5	Light brown clayey SAND with gravel	121.0	12.1	6,604	1.8

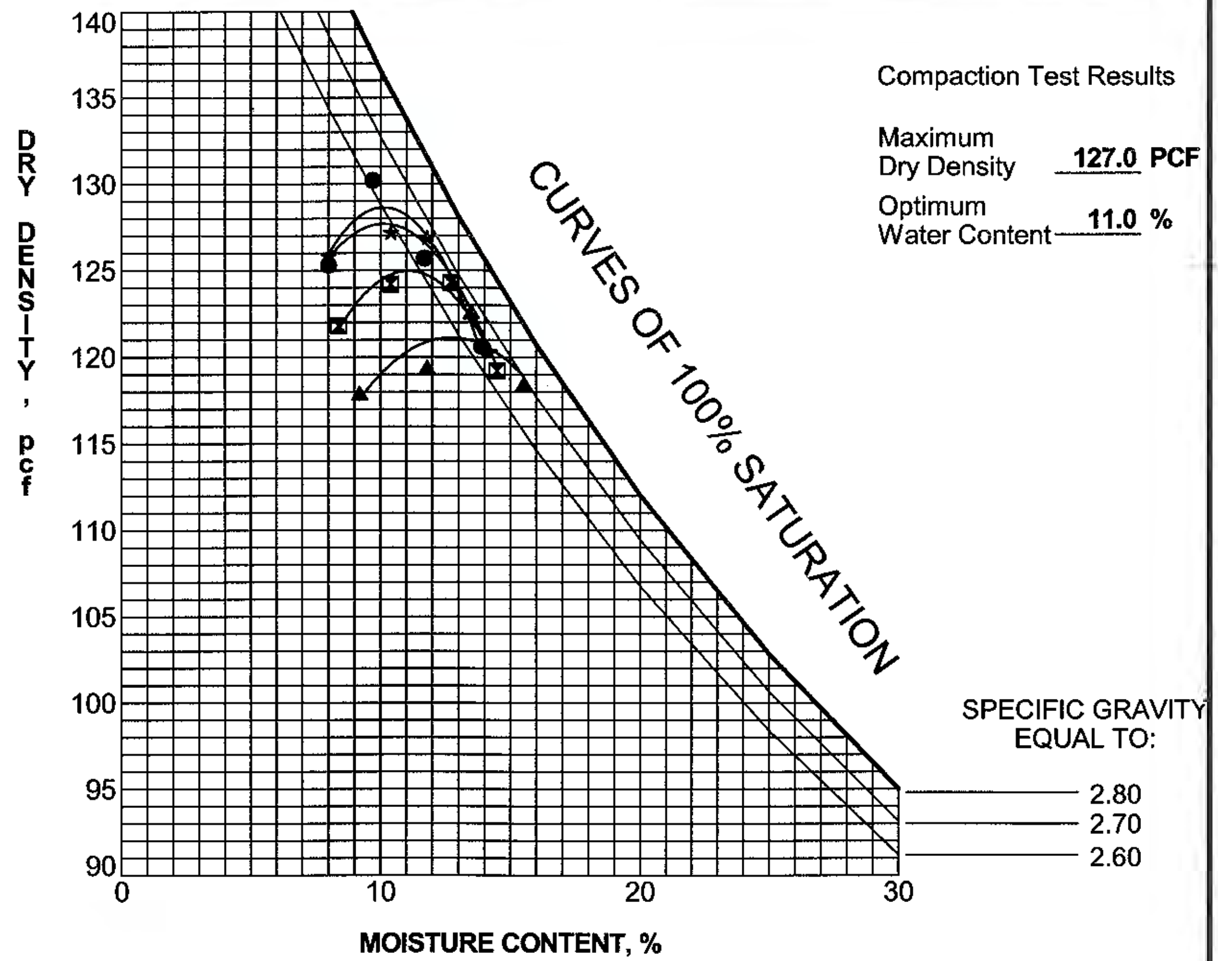
UNCONFINED COMPRESSION TEST

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

FUGRO

Project No. 1766.005

Plate B-8



Specimen Identification Sym	Sample	Date	Depth (ft)	Location	Passing ¾"	LL	PL	PI	C_c	C_u
●	B-02		3.0							
⊠	B-10		2.0							
▲	B-11		7.0							
★	B-19		3.0							

Specimen Identification			D_{100},mm	D_{60},mm	D_{30},mm	D_{10},mm	%Gravel	%Sand	%Silt	%Clay
●	B-02	3.0								
⊠	B-10	2.0								
▲	B-11	7.0								
★	B-19	3.0								

Key Symbol	Sample Number	Source	Sample Description	Maximum Dry Density (pcf)	Optimum Water Content (%)	Test Designation
●	B-02		Dark brown lean to fat CLAY with sand	130.0	9.5	ASTM D1557 Method B
⊠	B-10		Olive brown lean CLAY with sand & gravel	124.5	12.0	ASTM D1557 Method B
▲	B-11		Brown lean to fat CLAY with sand & gravel	122.5	13.5	ASTM D1557 Method B
★	B-19		Olive brown lean CLAY with sand & gravel	127.0	11.0	ASTM D1557 Method B

COMPACTION TEST RESULTS

Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

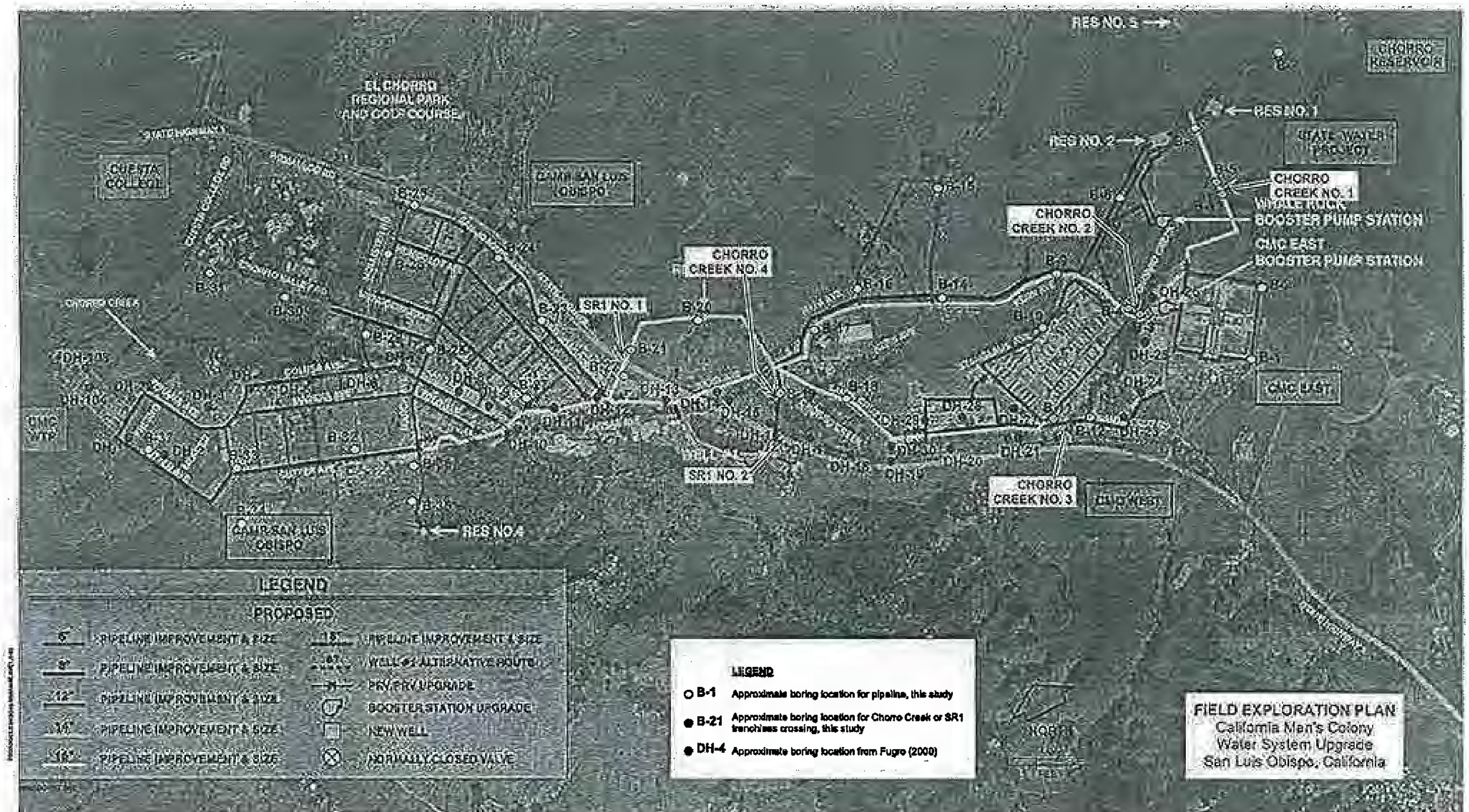
FUGRO

Project No. 1766.005

Plate B-9

APPENDIX C

PREVIOUS FIELD EXPLORATION



FIELD EXPLORATION PLAN
California Men's Colony
Water System Upgrade
San Luis Obispo, California

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	BLOW COUNT / REC"/DRIVE"	MATERIAL DESCRIPTION	
		1	25	Well graded GRAVEL (GW)	COARSE GRAINED
-12	2			Poorly graded GRAVEL (GP)	
-14	4	2	(25)	Well graded SAND (SW)	
-16	6	3	(25)	Poorly graded SAND (SP)	
-18	8	4	(25)	Silty SAND (SM)	
-20	10	5	18"/ 30"	Clayey SAND (SC)	
-22	12			Silty, Clayey SAND (SC-SM)	
-24	14	6		Elastic SILT (MH)	FINE GRAINED
-26	16	7		SILT (ML)	
-28	18	8	20"/ 24"	Silty CLAY (CL-ML)	
-30	20	9	(25)	Fat CLAY (CH)	
-32	22			Lean CLAY (CL)	
-34	24	10	30"/ 30"	CONGLOMERATE	ROCK
-36	26	11	20"/ 24"	SANDSTONE	
-38	28	12		SILTSTONE	
-40	30	13		MUDSTONE	
-42	32			CLAYSTONE	
-44	34			BASALT	
-46	36			ANDESITE BRECCIA	
-48	38			Paving and/or Base Materials	

LOCATION: The drill hole location referencing local landmarks or coordinates

SURFACE EL: Using local, MSL, MLLW or other datum

General Notes

Soil Texture Symbol

Sloped line in symbol column indicates transitional boundary

Samplers and sampler dimensions (unless otherwise noted in report text) are as follows:

Symbol for:	
1	SPT Sampler, driven 1-3/8" ID, 2" OD
2	CA Liner Sampler, driven 2-3/8" ID, 3" OD
3	CA Liner Sampler, disturbed 2-3/8" ID, 3" OD
4	Thin-walled Tube, pushed 2-7/8" ID, 3" OD
5	Bulk Bag Sample (from cuttings)
6	CA Liner Sampler, Bagged
7	Hand Auger Sample
8	CME Core Sample
9	Pitcher Sample
10	Lexan Sample
11	Vibracore Sample
12	No Sample Recovered
13	Sonic Soil Core Sample

Sampler Driving Resistance

Number of blows with 140 lb. hammer, falling 30" to drive sampler 1 ft. after seating sampler 6"; for example,

Blows/ft	Description
25	25 blows drove sampler 12" after initial 6" of seating
86/11"	After driving sampler the initial 6" of seating, 36 blows drove sampler through the second 6" interval, and 50 blows drove the sampler 5" into the third interval
50/6"	50 blows drove sampler 6" after initial 6" of seating
Ref/3"	50 blows drove sampler 3" during initial 6" seating interval

Blow counts for California Liner Sampler shown in ( )

Length of sample symbol approximates recovery length

Classification of Soils per ASTM D2487 or D2488

Geologic Formation noted in bold font at the top of interpreted interval

Strength Legend

- Q = Unconfined Compression
- u = Unconsolidated Undrained Triaxial
- t = Torvane
- p = Pocket Penetrometer
- m = Miniature Vane

Water Level Symbols

- ▽ Initial or perched water level
- ▼ Final ground water level
- Seepages encountered

Rock Quality Designation (RQD) is the sum of recovered core pieces greater than 4 inches divided by the length of the cored interval.

KEY TO TERMS & SYMBOLS USED ON LOGS

WEATHERING	
FRESH	The rock shows no discoloration, loss of strength, or any other effect due to weathering.
SLIGHTLY WEATHERED	The rock is slightly discolored, but not noticeably lower in strength than the fresh rock.
MODERATELY WEATHERED	The rock is discolored and noticeably weakened, but 2 inch diameter drill cores cannot usually be broken up by hand across the rock fabric.
HIGHLY WEATHERED	The rock is usually discolored and weakened to such an extent that 2 inch diameter core can be broken up readily by hand across the rock fabric. Wet strength usually much lower than dry strength.
EXTREMELY WEATHERED	The rock is discolored and is entirely changed to soil, but the original fabric of the rock is preserved. The properties of the soil depend upon the composition and structure of the parent rock.

INDURATION	
VERY WELL INDURATED	The rock is hard and strong, it will resist hammer blows.
WELL INDURATED	The rock is scratched with difficulty with a knife. It withstands one or two blows before breaking.
MODERATELY INDURATED	The rock is moderately hard and strong. The rock is readily scratched with a knife and leaves a heavy dust trace. It breaks with a single blow.
POORLY INDURATED	The rock is friable. It can be gouged deeply with a knife and crumbles under light hammer blows.
NONINDURATED	The sediments have only undergone compaction and/or slight cementation. Easily crumbled by slight hand pressure.

BEDDING THICKNESS	
MASSIVE	No visible or apparent bedding
VERY THICKLY BEDDED	Greater than 4 foot spacing
THICKLY BEDDED	2 to 4 feet
THINLY BEDDED	2 inches to 2 feet
LAMINATED	0.1 inch to 0.5 inch
THINLY LAMINATED	Less than 0.1 inch

HARDNESS	
VERY HARD	The rock cannot be scratched with a knife blade.
HARD	The rock is scratched with difficulty. The scratch leaves a little powder and is faintly visible.
MODERATELY HARD	The rock is easily scratched with a knife blade. The scratch is readily visible and leaves a heavy dust trace.
LOW HARDNESS	The rock can be easily and deeply carved with a knife blade.
SOFT	Can be molded with hand pressure.

GRAIN SIZE (SAND)	
FINE	0.0029 inch to 0.017 inch
MEDIUM	0.017 inch to 0.079 inch
COARSE	0.079 inch to 0.19 inch

SORTING
Very Well Sorted (uniform gradation)
Well Sorted
Moderately Sorted
Poorly Sorted
Very Poorly Sorted (well graded)

ANGULARITY
Angular
Subangular
Subrounded
Rounded
Well Rounded

BEDDING/JOINTING

FRACTURES / FOOT: The number of breaks in the core per foot including drilling-induced breaks, breaks from hammering on the core barrel to remove the core, and breaks from naturally occurring planes of weakness in the rock. It does not include intentional breaks in the core made by the logger to fit the core into the box.
Weak zones such as shear zones with many breaks are defined as contributing +50 fractures per foot to the interval when these weak zones are greater than 3 inches in width. Zones having a width of 3 inches or less are designated as contributing one fracture per foot to the interval.

NUMBER OF SETS: Refers to the number of fracture/joint sets including bedding.

ORIENTATION: Sketches in plan (box) view after realignment of core or alignment of bedding dips. The degree of inclination indicated numerically represents the actual fracture/jointing dip measured.

FRACTURE/JOINTING ROUGHNESS

VERY ROUGH: There are near vertical steps and ridges on the fracture surface.
ROUGH: Large annular asperities, some ridge and high-side angle steps are evident.
MEDIUM ROUGH: Asperities are clearly visible and the fracture surface feels abrasive.
SMOOTH: Essentially smooth to touch, may be slickensided.

COMPRESSION-WAVE VELOCITY: Solid line indicates average values.

MISCELLANEOUS:

Drilling rate varies with pressure on bit.
Core Recovery is the ratio of the length of core recovered in each run to the total length of the core run, in percent.
RQD is the ratio of the sum of the lengths of rock core pieces (4 inches or longer).
Color guide based on Munsell Color System.

TERMS AND DEFINITIONS USED FOR ROCK

PLATE A-1b

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	LOCATION: Southeast corner of Men's Colony East SURFACE EL: 445 ft +/- (rel. MSL datum) MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
444						**ARTIFICIAL FILL (af)** Lean CLAY (CL):							
442	2		1		(8)	**ALLUVIUM (Qal)** Fat CLAY (CH): firm, dark brown, moist, scattered gravel (1/4" diameter)	112	103	9				
440	4		2		9	- stiff, from 4 ft							p1.3
438	6												
436	8		3		(15)	- with light gray mottling, less gravel, orange staining, at 9 ft	125	99	26				
434	10												
432	12												
430	14		4		13	- with orange mottling, black mottling, pockets of light brown silt or crushed gravel, scattered sandstone gravel (1/4" diameter)							p2.8
428	16												
426	18												
424	20												
422	22												
420	24												
418	26												
416	28												
414	30												
412	32												
410	34												
408	36												
406	38												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 15.5 ft
DEPTH TO WATER: Not Encountered

DRILLING DATE: October 21, 2004

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Testing
LOGGED BY: C. Stoehr
CHECKED BY: LE Prentice R.G. C.E.G.

LOG OF BORING NO. B-01

CMC Water System
San Luis Obispo, California

Carollo Engineers
Project No. 3045.034

LOCATION: Approximately 50 feet East of Chorro Creek, North of Kern Avenue

SURFACE EL: 425 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
424				**ARTIFICIAL FILL (af)** Clayey SAND (SC): medium dense, moist							
	2	1	(21)		129	115	12				
422				Lean CLAY with sand (CL): very stiff, reddish brown, moist, scattered coarse gravel (1/2" diameter)							
	4	2	16						40	18	
420				Poorly-graded GRAVEL (GP): coarse gravel lense, consists of Claystone pieces							
	6			**ALLUVIUM (Qal)** Fat CLAY with sand (CH): stiff, dark brown, moist, subangular gravel (2" diameter), Claystone gravel							
418	8										
416		3	(14)		84	66	28				2.432762
414	10										
412	12										
	14	4	10	- coarse gravel (1/2" diameter) rounded, at 14 ft							p1.0
410	16										
408				- cobble noted during drilling, at 17 ft							
	18			- difficult drilling below 18 ft							
406		5	74/11"	**FRANCISCAN FORMATION (Kjfm)** CLAYSTONE (Rx): dark gray, extremely weathered, moderately soft, extremely fractured	146	130	12				
404	20										
402	22			- very difficult drilling below 23 ft							
400	24	6	50/0"	NOTE: refusal, at 24 ft							
398	26										
396	28										
394	30										
392	32										
390	34										
388	36										
386	38										

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 24.0 ft
DEPTH TO WATER: 16.5 ft
BACKFILLED WITH: Cuttings
DRILLING DATE: November 3, 2004

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Testing
LOGGED BY: C. Stoehr
CHECKED BY: LE Prentice R.G. C.E.G.

LOG OF BORING NO. B-03
CMC Water System
San Luis Obispo, California

PLATE A-4

FUGRO

LOCATION: Near Sta. 282+25

SURFACE EL: 431.0 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
430						**ALLUVIUM (Qal)** Lean CLAY with volcanic gravel (CL): light to dark brown, dry, with sand							
428	2		1		(20)	- stiff, damp, at 2.5'	113	94	20				PP 3.3
	4		P										
426			2		9				17				
424	6												
	8		3		(24)		118	109	8				
422													
420	10		4		7				24				
418	12												
416	14		5		(28)		133	110	21				
414	16					- with medium dense silty sand layer, from 16' to 16.5'							
412	18												
410	20												
408	22												
406	24												
404	26												
402	28												
400	30												
398	32												
396	34												
394	36												
392	38												

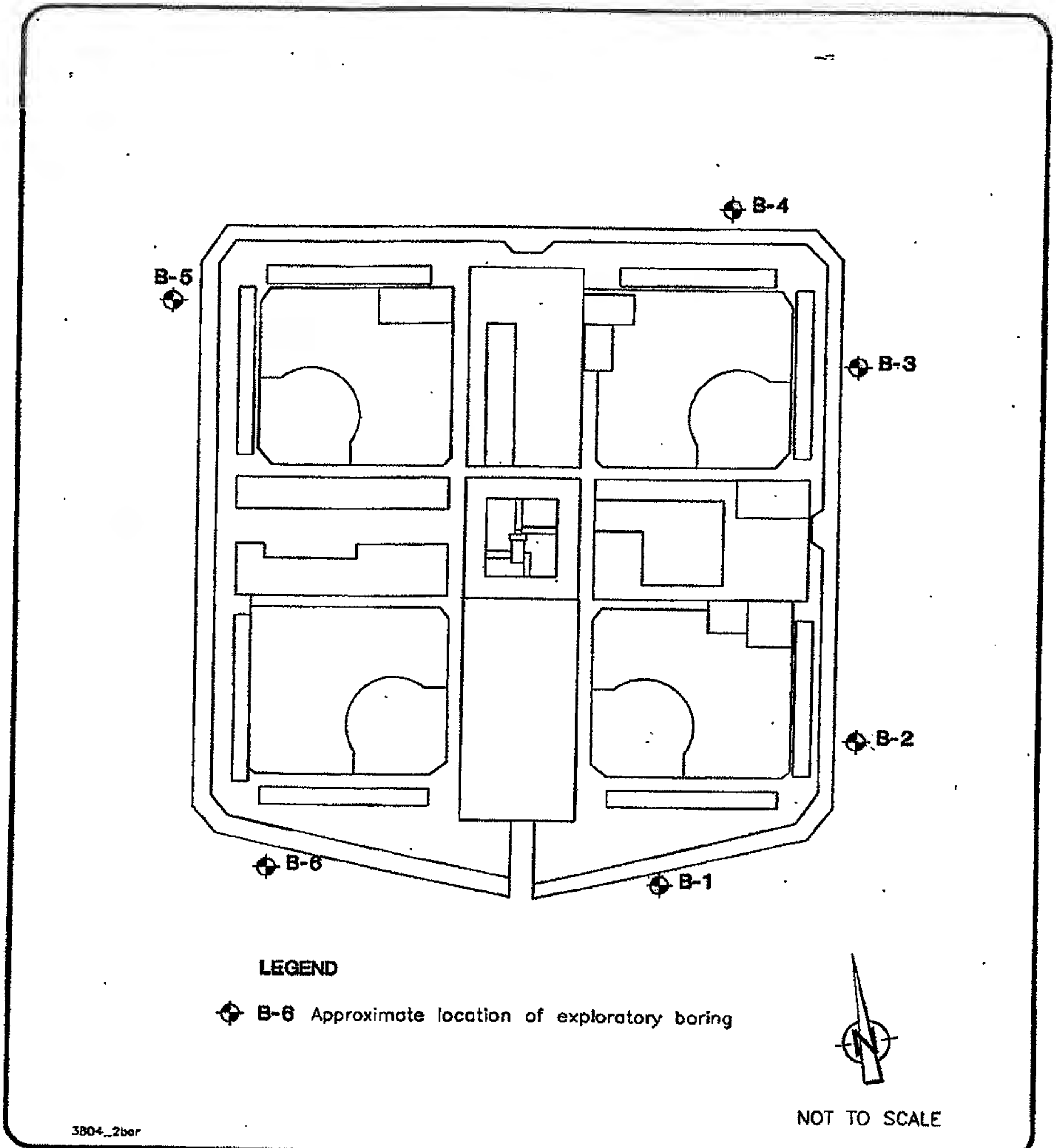
COMPLETION DEPTH: 16.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: January 13, 2000
The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

DRILLING METHOD: 8-in. dia. Hollow Stem Auger
HAMMER TYPE:
DRILLED BY: A & R Drilling, Inc.
LOGGED BY: NJDerbidge
CHECKED BY: GSDenlinger

LOG OF DRILL HOLE NO. DH-26

California Men's Colony Sewer Replacement
San Luis Obispo, California

DH LOG(99421051.GPJ/DH-026) REB
9/6/00 2:43:35 PM



Ninyo & Moore

BORING LOCATION MAP

CALIFORNIA MEN'S COLONY (EAST)
SAN LUIS OBISPO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
103804-02	11/98	2

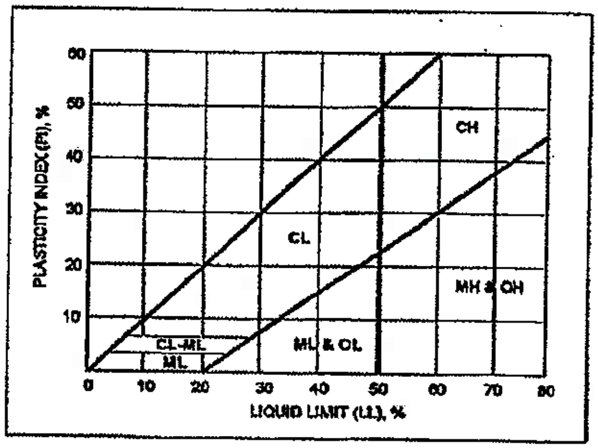
U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil >No. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction <No. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil <No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

CLASSIFICATION CHART (Unified Soil Classification System)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL Coarse Fine	3" to No.4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.074 4.76 to 2.00 2.00 to 0.420 0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

GRAIN SIZE CHART



PLASTICITY CHART

Ninyo & Moore	U.S.C.S. METHOD OF SOIL CLASSIFICATION

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 4 1/2" thick.
							GC	BASE: Brown, moist, medium dense, clayey gravel; approximately 3" thick.
							CH	FILL: Dark brown, moist, very stiff, fine to coarse sandy CLAY; scattered gravel and cobbles.
5		■	22	13.0	117.2			
								Increase in gravel/cobble.
								Total Depth = 7.1 feet (refusal). Groundwater not encountered during drilling. Backfilled on 11/9/98.
10								
15								
20								

DATE DRILLED 11/9/98 BORING NO. B-1

GROUND ELEVATION 190' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY RTW LOGGED BY RTW REVIEWED BY RI

Ninyo & Moore

BORING LOG

CALIFORNIA MEN'S COLONY (EAST FACILITY)
SAN LUIS OBISPO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
103804-02	11/98	A-1

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CH	FILL: Dark grayish brown, moist, stiff, fine sandy CLAY; few gravel.
			18	18.6	97.5			Dark yellowish brown; damp to moist.
			20	13.2	97.1			
5							CH	TOPSOIL: Dark brown to grayish black, moist, stiff, silty CLAY.
10			24	17.9	112.2			Very stiff.
								Total Depth = 10.5 feet. Groundwater not encountered during drilling. Backfilled on 11/9/98.
15								
0								

DATE DRILLED 11/9/98 BORING NO. B-2
GROUND ELEVATION 190' ± (MSL) SHEET 1 OF 1
METHOD OF DRILLING 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY RTW LOGGED BY RTW REVIEWED BY RI

Ninyo & Moore

BORING LOG

CALIFORNIA MEN'S COLONY (EAST FACILITY)
SAN LUIS OBISPO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
103804-02	11/98	A-2

DATE DRILLED: 11/9/98	BORING NO.: B-5
GROUND ELEVATION: 190' ± (MSL)	SHEET 1 OF 1
METHOD OF DRILLING: 8" Diameter Hollow-Stem Auger	
DRIVE WEIGHT: 140 lbs.	DROP: 30"
SAMPLED BY: RTW LOGGED BY: RTW	REVIEWED BY: RI

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SC	FILL: Dark yellowish brown, damp to moist, clayey fine to coarse SAND; with gravel.
							CH	TOPSOIL: Dark brown, damp to moist, hard, silty CLAY.
			48	8.9	122.9			FRANCISCAN FORMATION: Dark grayish brown, damp, intensely weathered SHALE; moderately to highly fractured.
5			89	7.5	123.3			
			50/5"	6.6	122.8			
10								Total Depth = 9.9 feet. Groundwater not encountered during drilling. Backfilled on 11/9/98.
15								
20								

Ninyo & Moore

BORING LOG

CALIFORNIA MEN'S COLONY (EAST FACILITY)
SAN LUIS OBISPO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
103804-02	11/98	A-5

APPENDIX D

PREVIOUS LABORATORY TESTING

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC %	FINES %	ATTERBERG LIMITS		COMPACTION TEST		DIRECT SHEAR		COMPRESSIVE STRENGTH TESTS		CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	SAND EQUIVALENT (SE)	TEST LISTING
								LL	PI	MAX DD pcf	OPT MC %	C ksf	PHI deg	Qu, ksf	S_u (Cell Prs.) ksf	R	pH	Cl	SO_4				
B-01	2.0	1	Fat CLAY (CH)	112	103	9																	T
B-01	4.0																						p
B-01	9.0	3	Fat CLAY (CH)	125	99	26																	T
B-01	15.0																						p
B-02	2.0	1	CLAYSTONE (Rx)			4																	M
B-03	2.0	1	Clayey SAND (SC)	129	115	12																	T
B-03	4.0	2	Lean CLAY with sand (CL)					40	18														A
B-03	9.0	3	Fat CLAY with sand (CH)	84	66	28									2.432762								T, UC
B-03	14.0	4	Fat CLAY (CH)																				p
B-03	19.0	5	CLAYSTONE (Rx)	146	130	12																	T
B-04	2.0	1	Fat CLAY (CH)	128	110	16									3.339625								T, UC
B-04	4.0	2	Silty CLAY (CL-ML)			15																	M, p
B-04	14.0	4	Silty CLAY (CL-ML)			12																	M
B-05	2.0	1	SILTSTONE (Rx)	139	128	9																	T
B-05	4.0	2	SILTSTONE (Rx)																				p
B-05	9.0	3	SILTSTONE (Rx)	143	128	12																	T
B-05	14.0	4	CLAYSTONE (Rx)																				p
B-05	19.0	5	CLAYSTONE (Rx) - Fat CLAY (CH)			6						0.7	30										M, D
B-05	24.0	6	CLAYSTONE (Rx)																				p
B-05	29.0	7	CLAYSTONE (Rx)	129	121	6																	T
B-06	2.0	1	SERPENTINITE	155	151	2																	T
B-06	9.0	3	SERPENTINITE	159	150	6																	T
B-07	2.0	1	Fat CLAY (CH)	91	75	21									5.371621								T, UC
B-07	4.0	2	Silty CLAY (CL-ML)																				p
B-07	9.0	3	SILTSTONE (Rx)	111	75	47																	T
B-08	2.0	1	Lean CLAY with gravel (CL)	124	109	14						0.7	34										T, D
B-08	4.0	2	Elastic SILT (MH)					61	26														A, p
B-08	9.0	3	CLAYSTONE (Rx)	118	104	14																	T
B-09	2.0	1	CLAYSTONE (Rx)	131	106	23																	T
B-09	9.0	3	CLAYSTONE (Rx)			14																	M

Classification Tests
UWW = Unit Wet Weight
UDW = Unit Dry Weight
MC = Moisture Content
Fines = % Passing #200 Sieve
LL = Liquid Limit
PI = Plasticity Index

Direct Shear Test
C = Assigned Cohesion, ksf
PHI = Assigned Friction Angle, degrees

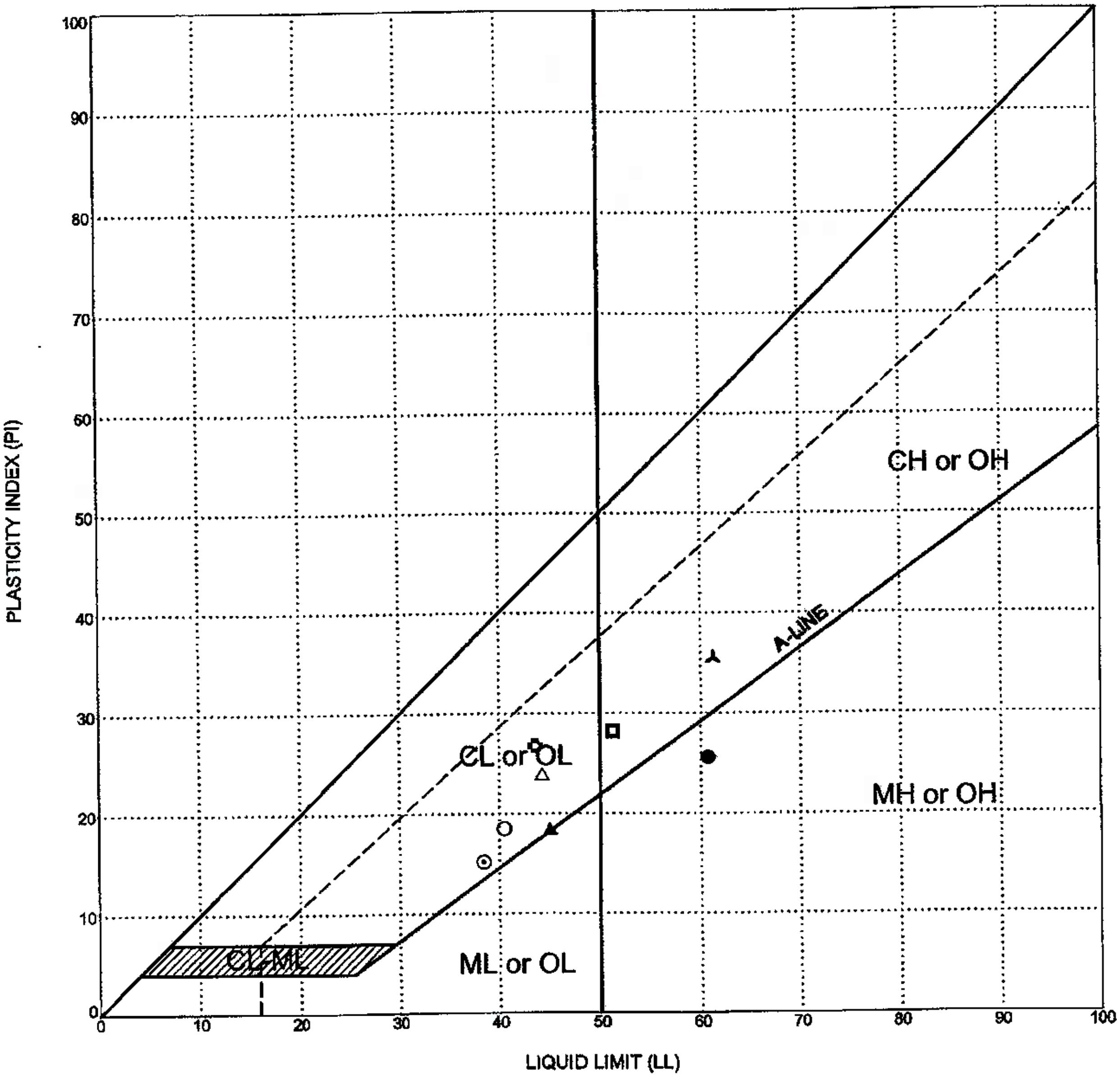
Compaction Test
MAX DD = Maximum Dry Density
OPT MC = Optimum Moisture Content

Compressive Strength Tests
Qu = Unconfined Compression
Su = Undrained Shear Strength
u = Unconsolidated Undrained
p = Pocket Penetrometer
t = Torvane
m = Miniature Vane

Corrosivity Tests
R = Resistivity, ohm-cm, satur.
pH = pH
Cl = Chloride, ppm
SO_4 = Sulfate, % by weight

Test Listing Abbreviations
M = Moisture Content
T = Total & Dry Unit Weight
S = Sieve Analysis
FC = % Passing #200 Sieve
H = Hydrometer Analysis
A = Atterberg Limits
P = Compaction Test
D = Direct Shear Test
C = Consolidation Test
Co = Corrosivity Tests
CU = CU Triaxial
U = UU Triaxial
R = R-Value
SE = Sand Equivalent

SUMMARY OF LABORATORY TEST RESULTS
CMC Water System
San Luis Obispo, California

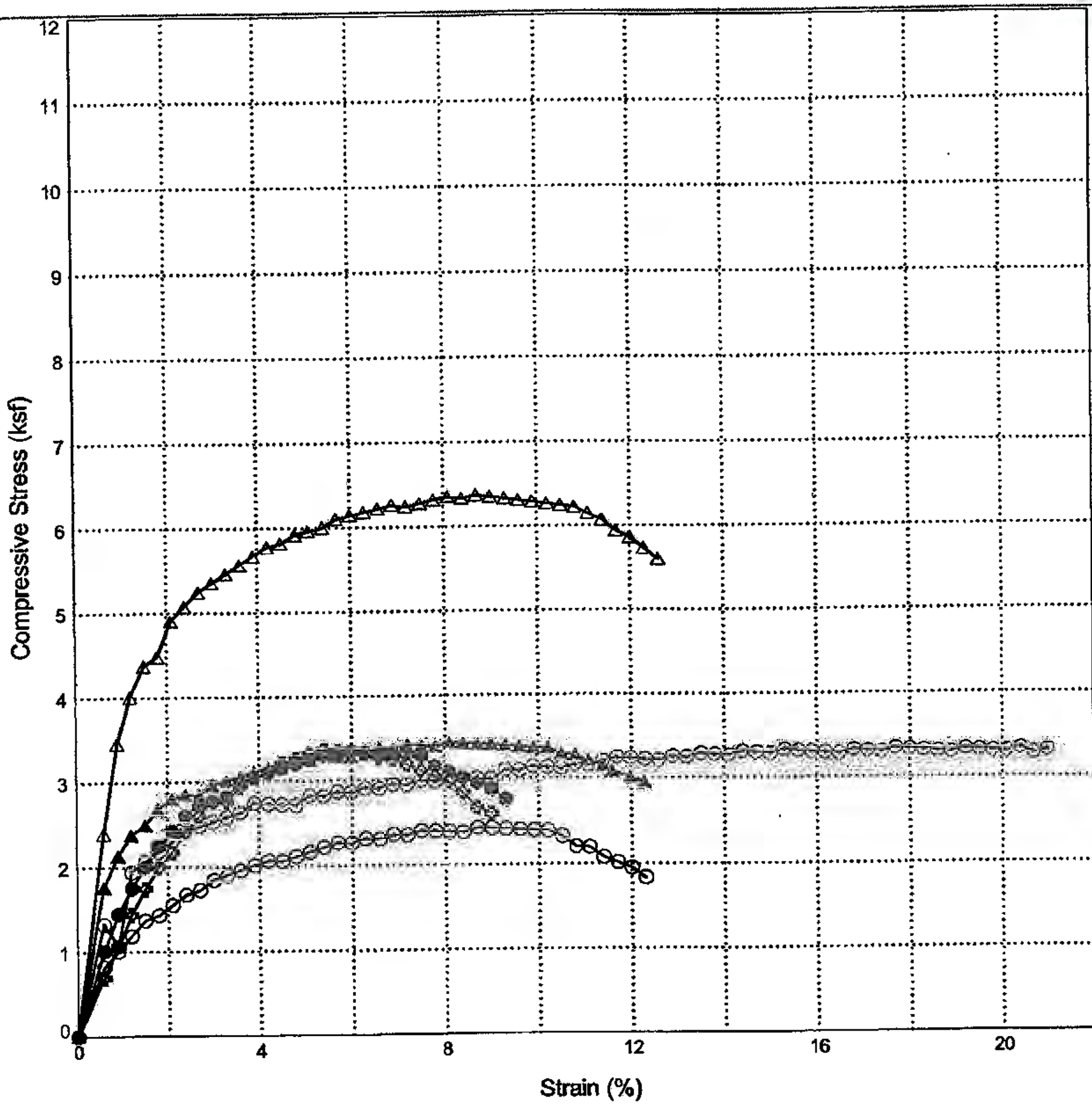


LEGEND			CLASSIFICATION	LIQUID LIMIT(LL)	PLASTIC LIMIT(PL)	PLASTICITY INDEX (PI)
	location	depth, ft				
○	B-03	4.0	Lean CLAY with sand (CL)	40	22	18
●	B-08	4.0	Elastic SILT (MH)	61	35	26
△	B-14	14.0	Lean CLAY with sand (CL)	44	20	24
▲	B-18	14.0	Clayey SILT (MH)/Lean CLAY (CL)	45	27	18
⊙	B-19	19.0	Lean CLAY (CL)	38	23	15
✪	B-23	10.0	Sandy Lean CLAY (CL)	44	17	27
⅄	B-25	10.0	Fat CLAY (CH)	61	26	35
◘	B-33	9.0	Sandy Fat CLAY (CH)	51	23	28

ATTERBERG LIMITS TEST RESULTS

PLASTICITY CHART
CMC Water System
San Luis Obispo, California

Carollo Engineers
Project No. 3045.034



LEGEND (location)	(depth,ft)	CLASSIFICATION	Dry Density (pcf)	% Moisture	S_u (ksf)
○ B-03	9.0	Fat CLAY with sand (CH)	66	28	1.2
● B-04	2.0	Fat CLAY (CH)	110	16	1.7
△ B-07	2.0	Fat CLAY (CH)	75	21	3.2
▲ B-15	2.0	Fat CLAY (CH)	102	21	1.7
⊙ B-25	13.5	Fat CLAY (CH)	114	21	1.7
✪ B-29	25.0	Fat CLAY (CH)	107	18	1.7

UNCONFINED COMPRESSION TEST RESULTS
CMC Water System
San Luis Obispo, California

DRILL HOLE	DEPTH, ft	MATERIAL DESCRIPTION	UWW	UDW	MC%	FINES %	ATTERBURG LIMITS		COMPACTION TEST		DIRECT SHEAR		COMPRESSIVE STRENGTH TESTS		CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	TEST LISTING
							LL	PI	MAX DD pcf	OPT MC %	C ksf	PHI deg	Qu ksf	Su, ksf	R	pH	Cl	SO_4			
DH-24	15.0	Silty SAND (SM) with gravel			19																M
DH-25	2.5	Sandy lean CLAY (CL)			8																M
DH-25	5.0	Sandy lean CLAY (CL)	97	87	12																T
DH-25	7.5	Sandy lean CLAY (CL)			7																M
DH-26	2.5	Lean CLAY (CL) with volcanic gravel	113	94	20																T
DH-26	5.0	Lean CLAY (CL) with volcanic gravel			17																M
DH-26	7.5	Lean CLAY (CL) with volcanic gravel	118	109	8																T
DH-26	10.0	Lean CLAY (CL) with volcanic gravel			24																M
DH-26	15.0	Lean CLAY (CL) with volcanic gravel	133	110	21																T
DH-27	2.5	Lean CLAY (CL)			15																M
DH-27	5.0	Basalt (Rx)	136	125	10																T
DH-27	7.5	Basalt (Rx)			5																M
DH-27	10.0	Basalt (Rx)	141	132	6																T
DH-27	15.0	Basalt (Rx)			9																M
DH-28	2.5	Lean CLAY (CL)			11																M
DH-28	5.0	Lean CLAY (CL)	111	98	12										6667	6.90	19				T,Co
DH-28	7.5	Lean CLAY (CL) with gravel layers			14																M
DH-28	10.0	Lean CLAY (CL) with gravel layers	114	84	36																T
DH-28	15.0	Lean CLAY (CL) with gravel layers			26																M
DH-29	2.5	Lean CLAY (CL) with gravel	121	103	18																T
DH-29	5.0	Lean CLAY (CL) with gravel			19																M
DH-29	7.5	Lean CLAY (CL) with gravel	114	85	35																T
DH-29	10.0	Lean CLAY (CL) with gravel			27																M
DH-29	15.0	Lean CLAY (CL) with gravel	116	90	29																T
DH-30	2.5	Lean CLAY (CL)			14																M
DH-30	5.0	Basalt (Rx)	126	112	12										4348	6.60	29	12			T,Co
DH-30	7.5	Basalt (Rx)			14																M
DH-30	10.0	Basalt (Rx)	121	109	11																T
DH-30	15.0	Basalt (Rx)			16																M
DH-101	2.5	Mixture of silty SAND and lean CLAY (CL)			16																M

Classification Tests
UWW = Unit Wet Weight
UDW = Unit Dry Weight
MC = Moisture Content
Fines = % Passing #200 Sieve
LL = Liquid Limit
PI = Plasticity Index

Direct Shear Test
C = Assigned Cohesion, ksf
PHI = Assigned Friction Angle, degrees

Compaction Test
MAX DD = Maximum Dry Density
OPT MC = Optimum Moisture Content

Compressive Strength Tests
Qu = Unconfined Compression
Su = Undrained Shear Strength
u = Unconsolidated Undrained
p = Pocket Penetrometer
t = Torvane
m = Miniature Vane

Corrosivity Tests
R = Resistivity, ohm-cm, satur.
pH = pH
Cl = Chloride, ppm
SO_4 = Sulfate, ppm

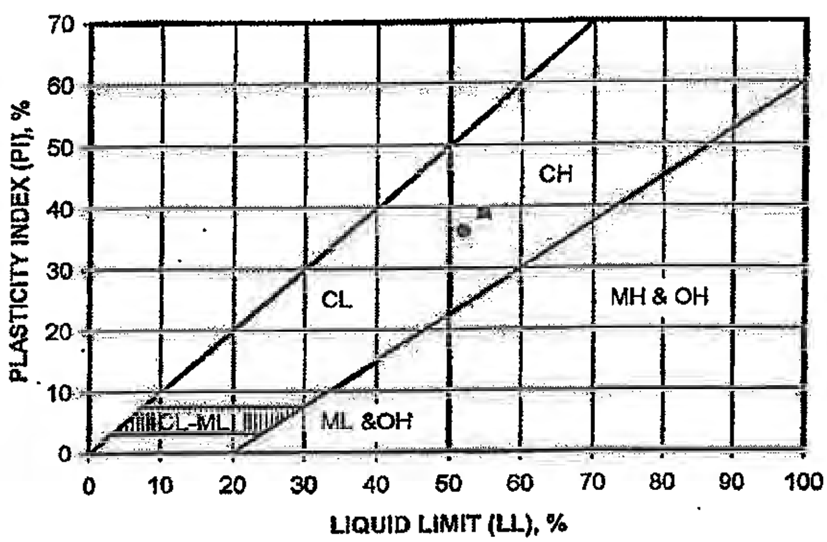
Test Listing Abbreviations
M = Moisture Content
T = Total Dry & Density
S = Sieve Analysis
FC = % Passing #200 Sieve
H = Hydrometer Analysis
A = Atterberg Limits
P = Compation Test
D = Direct Shear Test
C = Consolidation Test
Co = Corrosivity Tests
CU = CU Triaxial
U = UU Triaxial
R = R-Value (saturated)
E = Expansion Index

SUMMARY OF LABORATORY TEST RESULTS

California Men's Colony Sewer Replacement, San Luis Obispo, California

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	B-2	4.0-5.5	52	16	36	CH	CH
■	B-6	5.0-6.5	55	16	39	CH	CH

NP - Indicates non-plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-93

Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

CALIFORNIA MEN'S COLONY (EAST)
SAN LUIS OBISPO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
103804-02	11/98	B-1

3804-02AL

CORROSIVITY TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH *	RESISTIVITY * (ohm-cm)	WATER-SOLUBLE SULFATE CONTENT IN SOIL ** (percent)	CHLORIDE CONTENT *** (ppm)
B-5	1.0-2.0	7.7	725	0.090	45

* PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643
** PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417
*** PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422

Ninyo & Moore

CORROSIVITY TEST RESULTS

CALIFORNIA MEN'S COLONY (EAST)
SAN LUIS OBISPO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
103804-02	11/98	B-4

APPENDIX E

REMI / SEISMIC REFRACTION SURVEYS

REMI / SEISMIC REFRACTION SURVEYS

Introduction, Scope, and Objectives

This appendix outlines the results of conventional-seismic-refraction and Refraction Microtremor (ReMi) surveys that were performed on the site. The objectives of those seismic surveys were to collect geophysical data to help understand the subsurface soil-rock interface geometry and to estimate generalized site response characteristics. The refraction survey work was, in general, intended to identify the thickness of the surficial overburden soil and depths to the top of the bedrock layer.

The locations of the seismic survey lines are shown on Plate 5a. The lines were laid out in an orthogonal pattern, so that they followed the pattern of soil borings drilled at the site. Four conventional P-wave seismic refraction surveys were performed (Lines 1, 2, 3, and 5) and seven 1-D and 2-D ReMi surface-wave surveys were performed (Lines 1 through 7).

The conventional refraction-survey work was performed in general accordance with the requirements of ASTM Standard D5777-00 (Reapproved 2006). The ReMi surface-wave survey work was performed in general accordance with the procedures described by Louie (2001).

Seismic refraction survey Methodology

The conventional seismic-refraction survey technique is widely used as a non-destructive site characterization method. The method is commonly used for estimating the depth to bedrock and/or the water table, mapping faults, estimating formation thicknesses, and measuring compressional wave (P-wave) velocities.

The seismic refraction technique measures arrival-times of compression (P) body-waves produced by a near-surface energy source. Those waves travel from the source through the earth to a linear array of detectors (called a seismic spread) placed on the ground surface. The source positions for our surveys were in-line within the seismic spread (i.e., between selected geophone locations). Depending on the subsurface conditions, the seismic body-waves travel directly to the seismic detectors (direct arrivals) or along critical and non-critical refraction paths at acoustic boundary interfaces (refracted arrivals). The refractor interfaces represent boundaries between earth layers that exhibit distinct P-wave propagation velocity contrasts.

In practice, the desired depth of investigation and velocity contrasts determine the optimum survey parameters such as seismic refraction line length, number of detectors (geophones) on a line, and geophone spacing. For the shallow refraction surveys performed at this site, we used spreads of 24 geophones placed on the asphaltic concrete parking lot surface and connected to a seismograph using a signal transmission cable. Down-going seismic energy was generated by striking an aluminum plate placed on the pavement with a 20-pound sledgehammer. At depth, along velocity boundary interfaces, P-waves are critically refracted back to the surface as plane-wave head-waves.

The geophones detect those critically refracted head-waves as vertical particle motion (P-waves) on the surface. The seismic refraction data are converted to electrical signals and transmitted through a seismic refraction cable (which is connected to all geophones along the seismic spread) and then recorded in the seismograph. Seismograph trigger timing is controlled by a trigger switch, which is mounted on the hammer energy source, so that zero time is known and the refraction arrival times for each multi-channel seismic record can be measured.

In processing the refraction data, a time-distance relationship of the first arrivals is used to determine the depth and thickness of the layers, and the velocities. The data recorded on the seismograph system are processed and interpreted using computer software.

Refraction Microtremor (Remi) Methodology

To supplement our conventional seismic-refraction survey results, an estimate of the propagation velocity (also called phase velocity) of the surface waves was performed to develop generalized one-dimensional and two-dimensional shear-wave velocity profiles through the site. The surface-wave velocity analyses were performed using the non-destructive, passive technique referred to as ReMi (Refraction Microtremor) (Louie, 2001; Stephenson et al., 2005; Jaume et al., 2005).

The ReMi technique uses surface waves generated by noise (e.g., traffic, equipment, wind, hammer impacts, etc.) to estimate subsurface soil velocity characteristics. The basis of surface wave methods is the dispersive characteristic of Rayleigh waves when propagating in a layered medium. The Rayleigh-wave phase (propagation) velocity primarily depends on the material properties to a depth of about one wavelength. Different phase velocities result as longer-period waves sample deeper soil layers. The variation of phase velocity with frequency (i.e., wavelength) is called dispersion.

For our ReMi analyses, seven arrays of 24 10-Hz geophones were arranged in linear spreads on the asphaltic-concrete parking lot pavement. Two of the lines used a 15-foot horizontal spacing between the geophones (Lines 4 and 5) and five (Lines 1, 2, 3, 6, and 7) used a 10-foot horizontal spacing. The spreads were oriented approximately east-west and north-south in an orthogonal pattern aligned with the boring locations.

Seven, 30-second-long ReMi seismic records (each with a 2 millisecond sampling interval) were gathered along each of the seven spreads. For those records, a pickup truck was driven along each line to provide the necessary seismic energy source. The vibrations from the truck were supplemented by hammer blows struck on the pavement at various positions along each line. The recorded data were processed and interpreted using computer software.

Field Operation

The field operation was carried out on June 28, 2009. Seismic data were collected along the 7 lines shown on Plate 5a. Summary details of the seismic survey lines are shown in Table 1.

Table 1

Line No.	Type of Survey	Geophone Spacing, ft	Shots Per Spread	Line Length, ft
1	Refraction	10	5	230
1	ReMi	10	-	230
2	Refraction	10	5	230
2	ReMi	10	-	230
3	Refraction	10	5	230
3	ReMi	10	-	230
4	ReMi	15	-	345
5	Refraction	15	7	345
5	ReMi	15	-	345
6	ReMi	10	-	230
7	ReMi	10	-	230

Coordinates of the seismic line end points were measured using a GPS system consisting of a Trimble Pro-XR utilizing post-processed kinematic carrier-phase data. Geophone elevations were estimated from the project's topographic base map.

A 20-pound sledgehammer striking an aluminum plate was used as the seismic energy source for the conventional refraction lines. The seismograph consisted of a 24-channel DAKLINK II seismograph manufactured by Seismic Source, Inc. Data display in the field was performed using a laptop personal computer. For all of the surveys, we used 24 10-Hz vertical-component geophones and the cables used had Mueller clip takeouts.

Each of the 7 seismic lines consisted of a 24-channel spread with a geophone spacing of either 10 or 15 feet. The shortest spread was 230 feet long (23x10-feet) and the longest spread was 345 feet long (23x15-feet). For each conventional refraction spread, 3 interior shot points were used; one at the center of the spread and one on either side of that about half way between the center of the spread and the first and last geophones. Two off-end shots were used for each conventional refraction spread; positioned about 5 or 7.5 feet (1/2 of the geophone spacing) beyond the first and last geophones (except for Line 3, where the presence of a fence required that we move one of the off-end shots). Because refraction Line 5 used a15-foot spacing, we added two additional interior shot points on that spread. On all conventional seismic refraction lines, compressional-wave (P-wave) data were collected from repeated and stacked hammer impacts.

ReMi Data Analysis

The raw ReMi data were downloaded to a personal computer for evaluation. The ReMi data were processed using the ReMiVspect and ReMiDisper computer programs developed by Optim, Inc. In those programs, a slowness-frequency (p-f) wave-field transform is used to separate Rayleigh surface wave energy from that of other waves (slowness is the inverse of phase velocity). The wave-field transform is conducted for a range of velocity vectors through the geophone array, all of which are summed using the slant-stack technique. The dispersion curves picked to model each of the seven spreads are along the lower envelope of the summed Rayleigh wave energy in p-f space. After picking the Rayleigh-wave dispersion curves, an interactive modeler is used to model subsurface soil profiles that provided a good fit to the dispersion curves.

On the basis of our one-dimensional ReMi velocity surveys of the area, it appears that the shear wave velocity of the soil materials along each of those ReMi lines generally increases with depth. The overburden zone has an average shear wave velocity of about 360 to 920 feet per second (ft/sec). Below that overburden zone, the average shear wave velocity of the bedrock ranges from about 5000 to 6000 ft/sec. These average shear wave velocities were used to calculate the Vs100 value using methods and equations from the 2007 CBC, Section 1613A.5.5, Site classification for seismic design. A composite plot that shows the one dimensional shear wave velocity models from each of the seven ReMi lines is shown on Plate E-1.

To develop generalized two-dimensional shear-wave velocity-profiles from the surface-wave data, we also processed the ReMi data from each line in a series of overlapping segments that were subsequently combined together. For that processing, each segment, which consisted of the records from eight consecutive geophones (e.g., 1 through 8), was processed to produce a one-dimensional profile applied at the center of that segment. That process was repeated with the next segment of eight records (e.g., 2 through 9) and its one-dimensional result was applied at the center of that segment. When all 17 of the 8-geophone-segments were processed, their individual one-dimensional results were combined to produce a generalized two-dimensional shear-wave velocity-profile of the entire line. The resulting plots from that two-dimensional processing are shown on Plates E-2 through E-5.

Refraction Data Analysis

The raw conventional seismic-refraction data were downloaded to a personal computer for evaluation. The first arrivals (first-break picks) were selected using the computer program Picker from Optim, Inc. After first arrivals were chosen, the computer program IXRefraX, from Interprex, Inc., was used to perform General Reciprocal Method (GRM) analyses of the data.

The results of the conventional refraction-surveys are presented as interpreted velocity-depth sections on Plates E-6 and E-7. Those interpreted sections (two-layer models) are the output from IXRefraX. Each of the velocity sections depicts the interpreted, irregular, subsurface boundary between the overburden materials and the underlying bedrock. The plots also show the positions of nearby exploratory borings, projected into the section lines. The depth to bedrock as encountered in each boring is indicated by an "X". The approximate seismic-wave propagation velocities calculated by IXRefraX for the overburden and bedrock materials are labeled on the profiles. For display purposes, the colored bedrock section is extended to the base of each section line, but the posted bedrock velocities are actually from refractions that travel along the overburden-bedrock interface and do not represent velocities at depth within the bedrock.

On the basis of the spot velocities noted on the conventional seismic-refraction profiles performed for this study, the approximate P-wave velocity estimated for the overburden materials at the site ranged from about 2200 to 3300 ft/s. The approximate P-wave velocity estimated for the bedrock materials varied from about 7000 to 13,000 ft/s. The time-distance curves indicate that both horizontal and vertical variations in velocity occur in both the overburden and bedrock materials. The high P-wave velocities noted in the seismic refraction data indicate that areas of hard to very-hard bedrock, which may be difficult to excavate with conventional equipment, are likely to be encountered at the site.

Consistency of Data

The seismic velocity sections generated from our conventional seismic-refraction data and our ReMi data typically compare well with the results of the nearby drill holes. In most cases, the elevation differences between the boring data and the refraction data are minor, on the order of several feet. The bedrock elevations at the intersections between the various refraction lines also correlate well with each other, generally within several feet.

The inter-line differences between the refraction results, and the differences between the refraction data and the boring data may be due to several factors. One factor is the velocity used to model the overburden materials. The computer program used to analyze the refraction results, estimates average vertical velocities for the materials at various locations along the line. Because the seismic-wave propagation velocity typically changes vertically, the deviation of the average from the actual velocities probably has an influence on the observed depth differences. In addition, the modeling process assumes that the refractions are returned from a position located vertically below and within the vertical plane through the geophone spread. In reality, the first-arrival head-waves can be refracted from features that are outside of that vertical plane, which also can result in differences.

Perhaps the most significant factor affecting data consistency is the inhomogeneous nature of the bedrock materials at this site. The Franciscan Formation commonly has zones of lower-velocity weathered- to extremely-weathered-rock near the surface with localized higher-velocity hard to very hard zones of unweathered rock at randomly dispersed locations. The seismic waves respond to differences in wave propagation velocity between overburden and bedrock materials, which may not correlate with the actual overburden/bedrock interface logged on the borings.

Limitations

The objective of this geophysical survey was to estimate the geometry and velocities of the near-surface geologic units using conventional seismic refraction methods and passive surface-wave techniques within the resolution of the equipment. The results of our survey are based on our interpretation of recorded geophysical data and should not be construed as absolute fact. The conventional seismic refraction method may not detect thin, intermediate velocity layers (blind zones) or lower velocity layers beneath higher velocity layers (hidden zones). The unrecognized presence of either of those zones can result in incorrect velocity sections. Also, because seismic waves travel in all directions (not just vertically), the cross-section depths may not always be vertical depths (i.e., there may be out-of-plane effects). The ease of excavation may decrease as the harder layer is approached and may not occur suddenly at a specific interface. The positions of the layers indicated on the velocity sections may be only generalized and the transitions from softer to harder units may be gradational.

We have performed the services specified in this project in a manner consistent with the level of care and skill ordinarily exercised by members of the engineering profession currently practicing under similar conditions. We do not warrant nor guarantee that acquisition, compilation, and analysis of acquired geophysical data will yield desirable or anticipated results, such as properly ascertaining the local geology. Fugro will not be held responsible for any damages to the owners or contractors as a result of geologic hazards that may be present and were not identified by our geophysical surveys.

References

ASTM D5777-00 (Reapproved 2006), Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation.

Jaume, S.C., Levine, N., Brown, C.H., and Cooper, S.L. (2005), "Shallow Shear Wave Velocity Structure of the Charleston Historical District, South Carolina: Comparison of Surficial Methods and Borehole Results," USGS Grant 05HQGR0072.

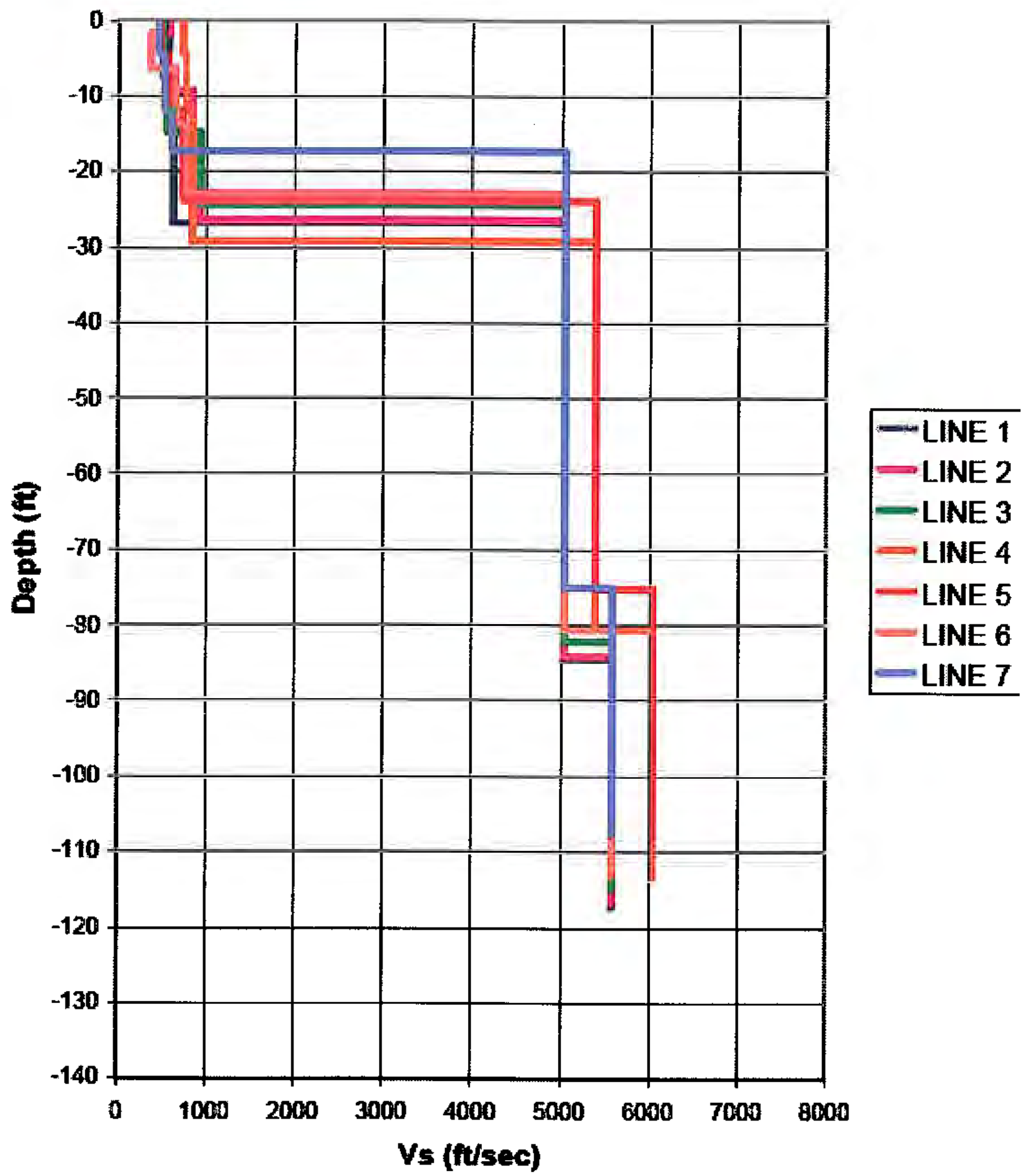
Louie, J.N. (2001), "Faster, Better: Shear-Wave Velocity to 100 Meters Depth from Refraction Microtremor Arrays," Bulletin of the Seismological Society of America, Vol. 91, No. 2, pp. 347-364.

Massarsch, K.R. and Broms, B.B. (1991), "Damage Criteria for Small Amplitude Ground Vibrations," Proceedings: Second International Conference on Recent advances in Geotechnical Earthquake Engineering and Soil Dynamics, March 11-15, St. Louis, Missouri, Paper No. 11.5, pp. 1451-1459

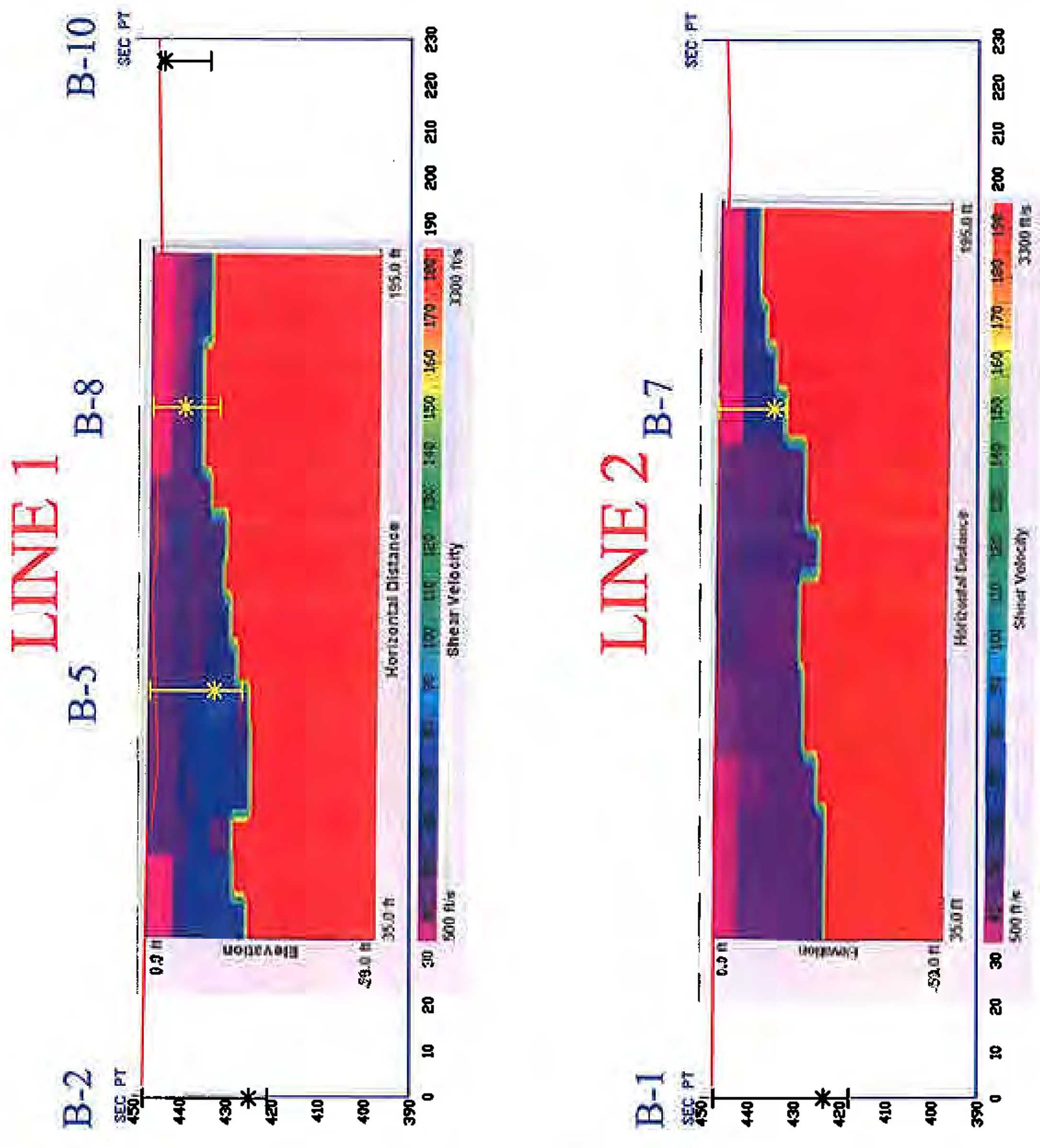
Massarsch, K.R. (1993), "Man-Made Vibrations and Solutions," Proceedings: Third International Conference on Case Histories in Geotechnical Engineering, St. Louis, Missouri, June 1-4, SOA 9, pp. 1393-1405.

Stephenson, W.J., Louie, J.N., Pullammanappallil, S., Williams, R.A., and Odum, J.K. (2005), "Blind Shear-Wave Velocity Comparison of ReMi and MASW Results with Boreholes to 200 m in Santa Clara Valley: Implications for Earthquake Ground-Motion Assessment," Bulletin of the Seismological Society of America, Vol. 95, No. 6, pp. 2506-2516.

SHEAR WAVE VELOCITY



SHEAR WAVE VELOCITY COMPOSITE PLOT
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

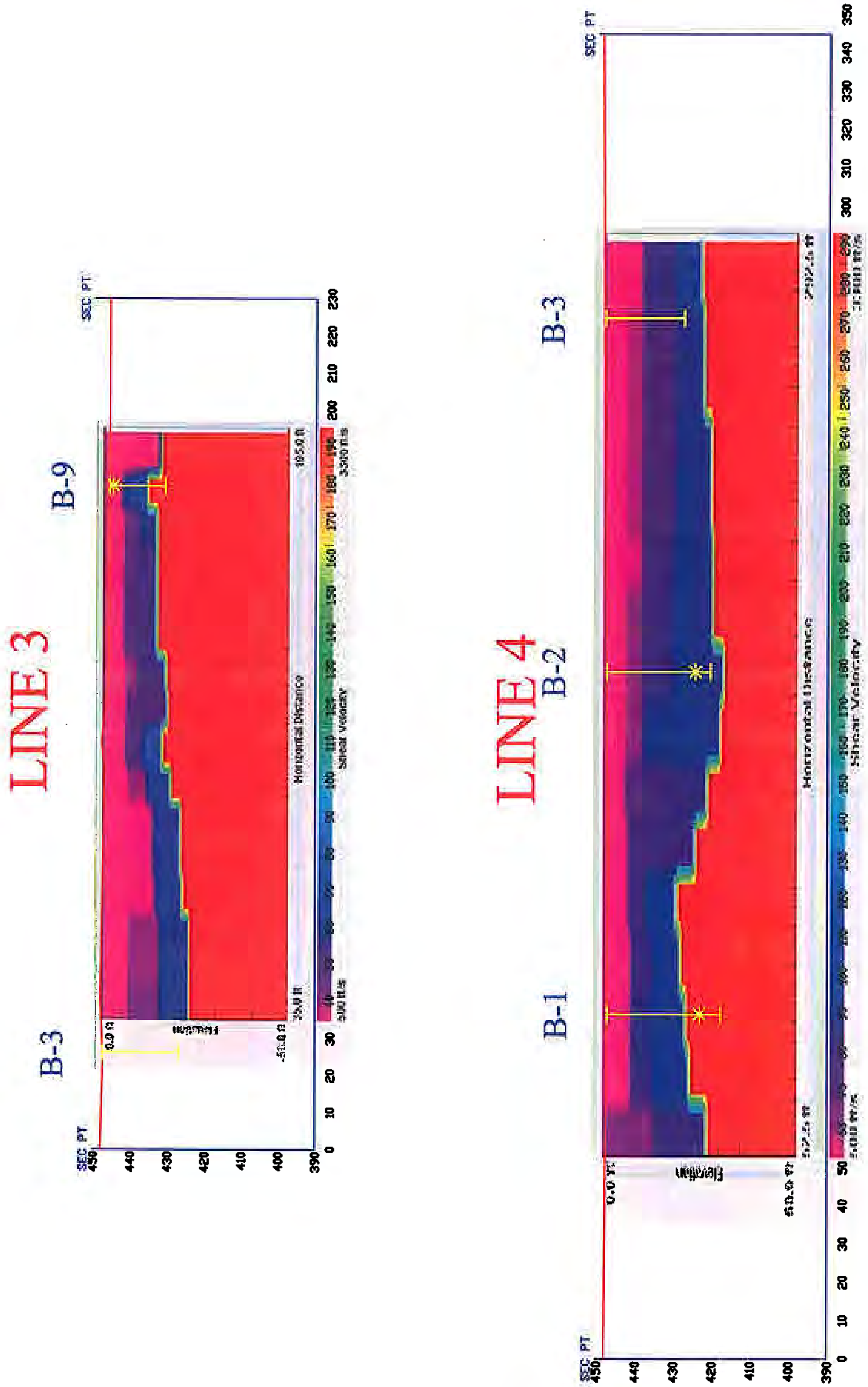


LEGEND

B-1 Exploratory Boring

* Depth To Franciscan Formation Identified in Boring

ReMi SURVEYS
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

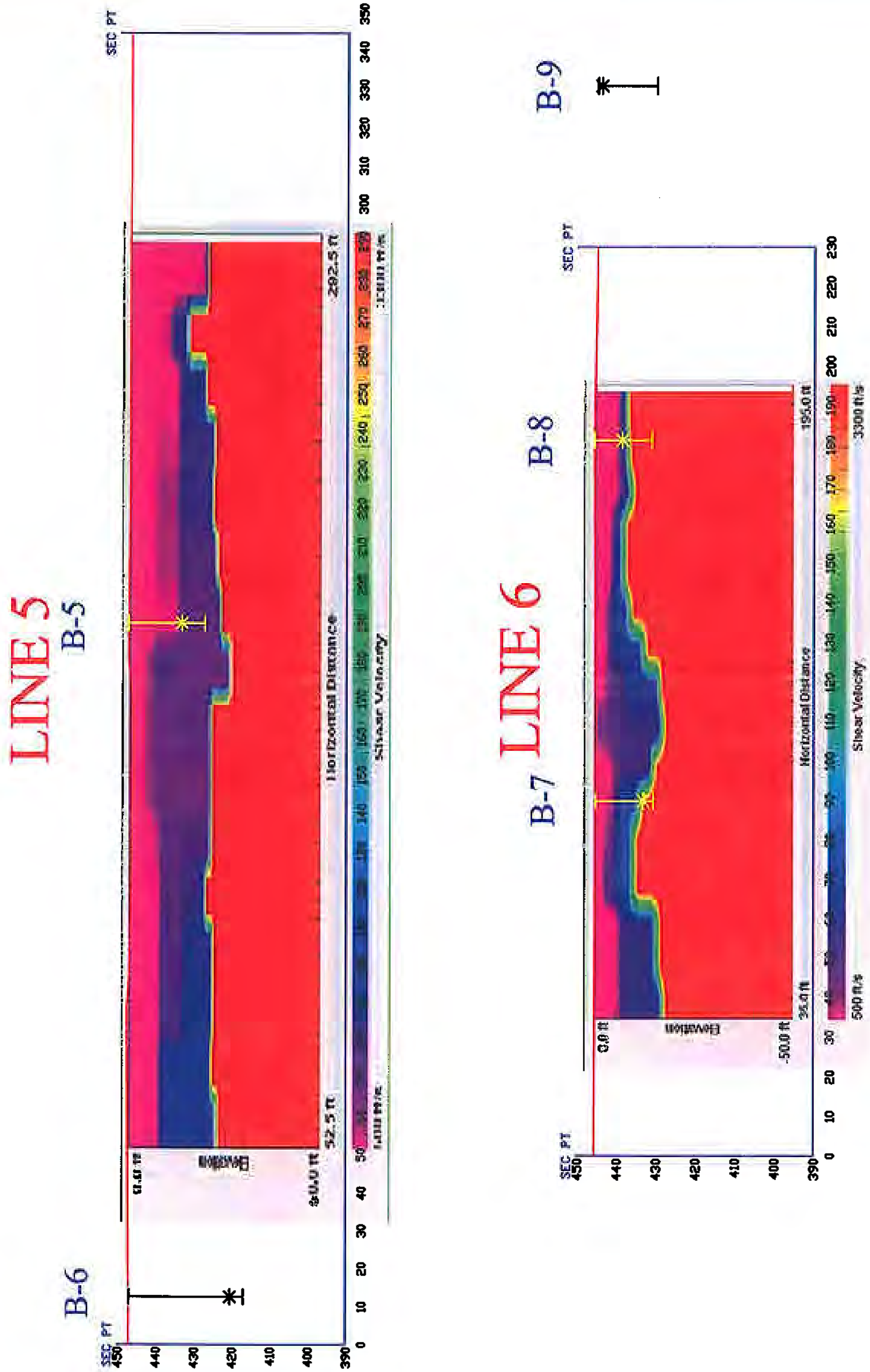


LEGEND

B-1 Exploratory Boring

* Depth To Franciscan Formation Identified in Boring

ReMi SURVEYS
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

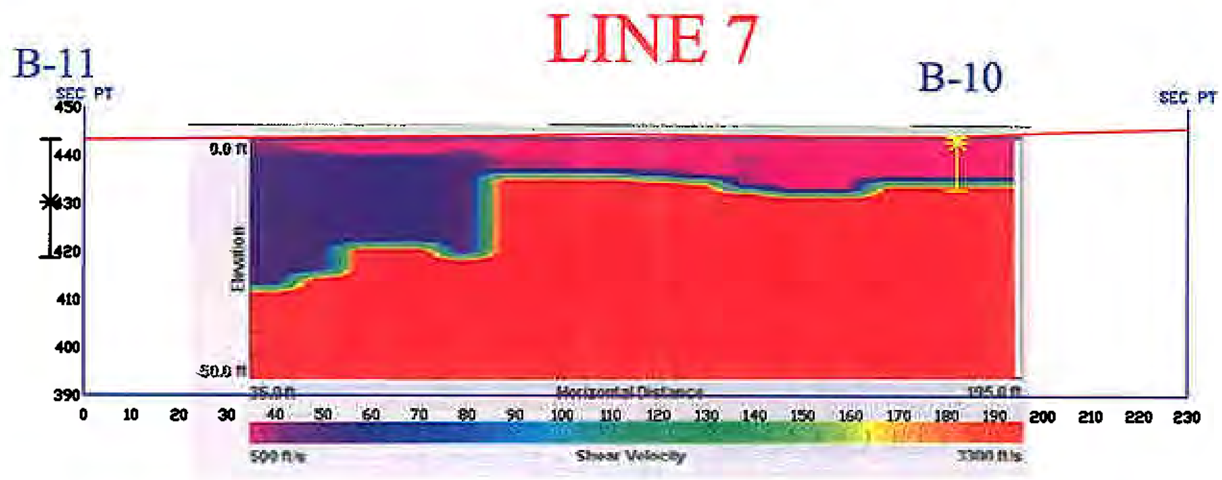


LEGEND

B-1 Exploratory Boring

✱ Depth To Franciscan Formation Identified in Boring

ReMi SURVEYS
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

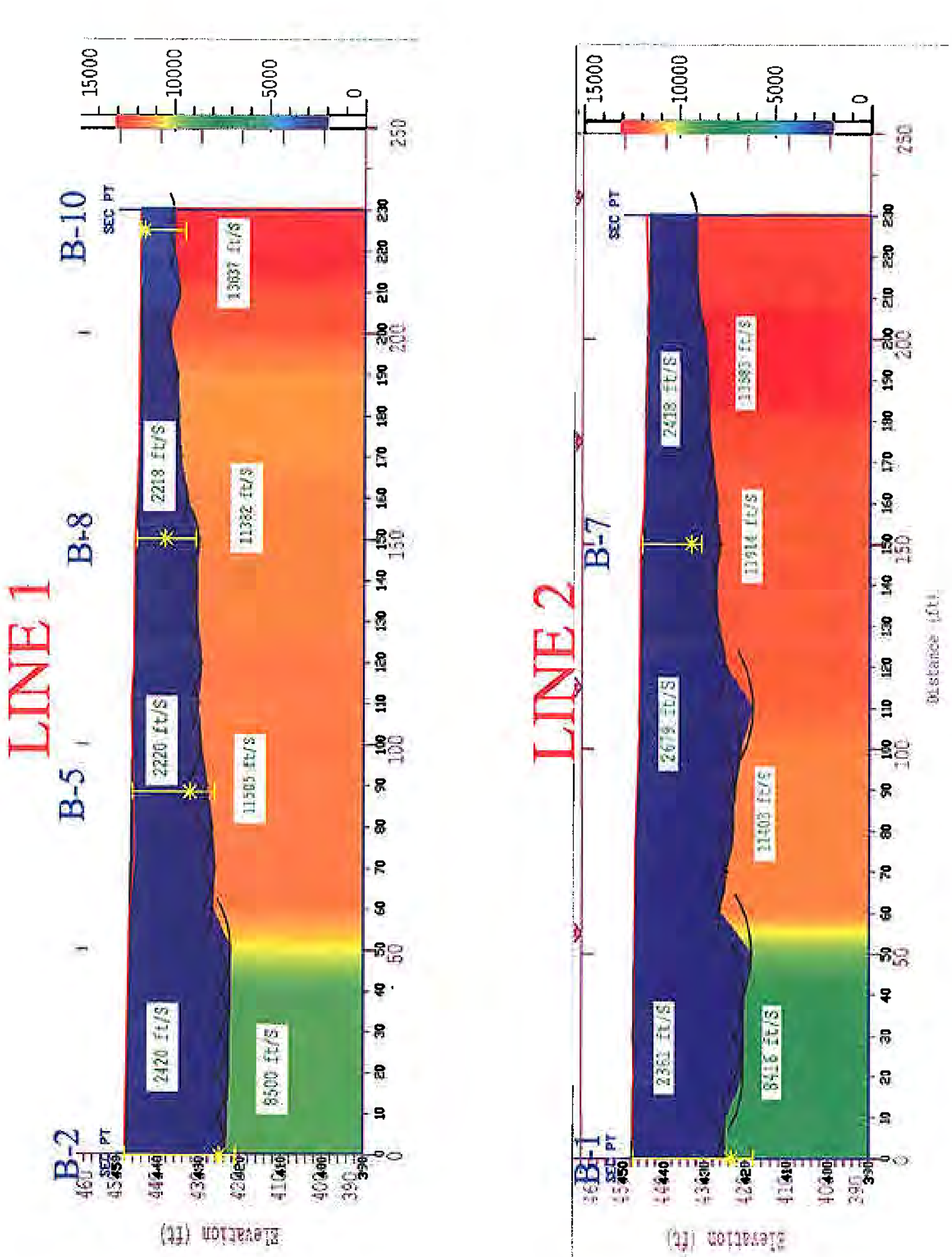


LEGEND

B-1 Exploratory Boring

$\ast$ Depth To Franciscan Formation Identified in Boring

ReMi SURVEYS
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

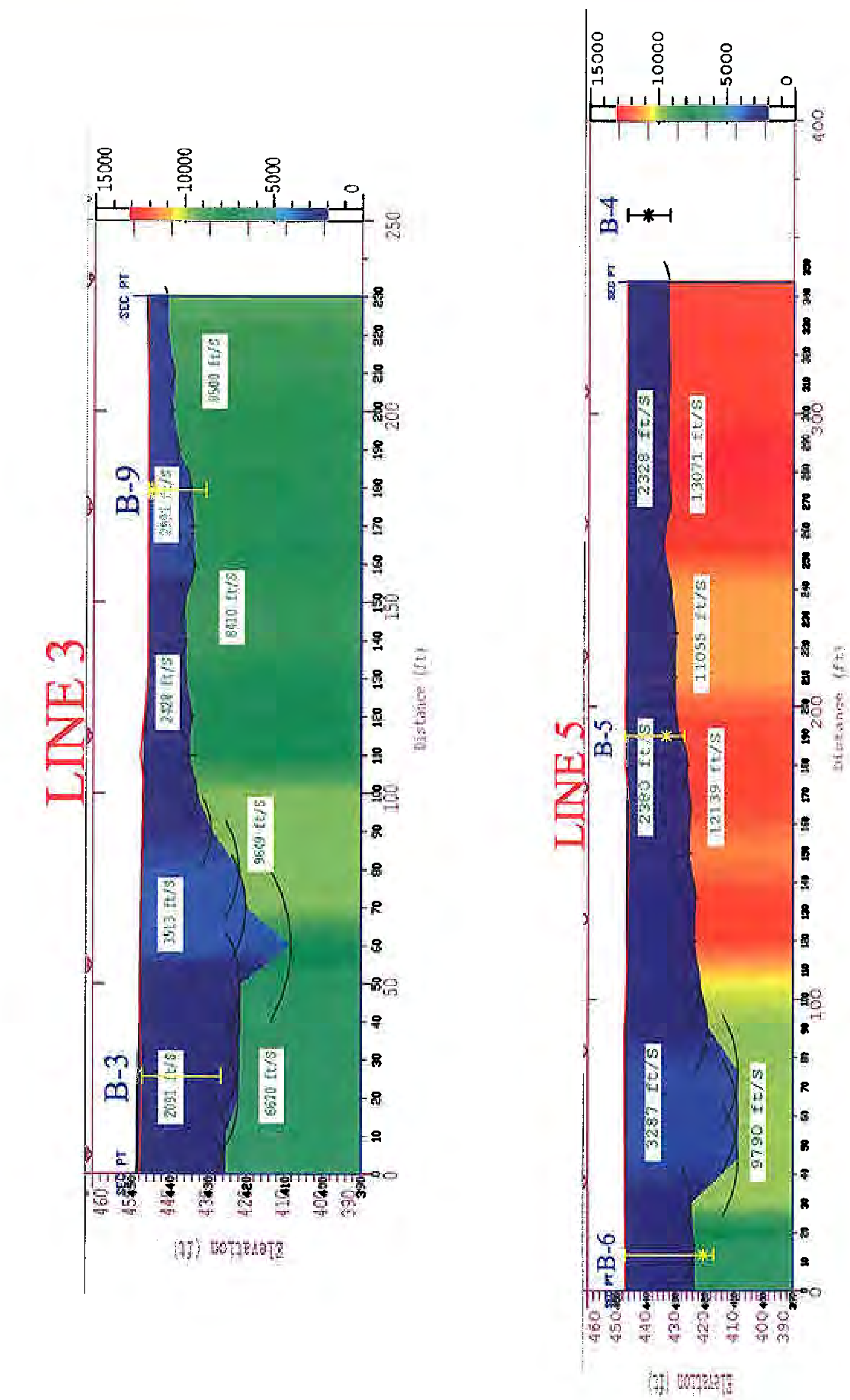


SEISMIC REFRACTION SURVEYS
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

LEGEND

B-1 Exploratory Boring

✱ Depth To Franciscan Formation Identified in Boring



LEGEND

B-1 Exploratory Boring

Depth To Franciscan Formation Identified in Boring

SEISMIC REFRACTION SURVEYS
Mental Health Crisis Beds
California Men's Colony
San Luis Obispo, California

PLATE E-7

APPENDIX F

SOIL SHRINKAGE POTENTIAL

ESTIMATED SOIL SHRINKAGE POTENTIAL						
Boring No.	**Test Depth (ft)**	**In-Place Dry Density (pcf)**	**Maximum Dry Density* (pcf)**	**Percentage Shrinkage at 92% Comp.**	**In-Place Moisture (%)**	**Optimum Moisture* (%)**
B-2	4	128.4	130	-7	9.7	9.5
B-6	2.5	113.9	130	5	13.8	9.5
B-7	4	139.0	122.5	-19*	7.6	13.5
B-10	2.5	119.8	124.5	-4	13.6	12
B-10	7	123.9	122.5	-9	9.1	13.5
B-13	4	133.0	124.5	-14*	3.6	12
B-14	2.5	114.6	124.5	0	15.5	12
B-16	4	95.7	127	22*	15.4	11
B-19	2.5	121.0	127	-3	12.1	11

Note: * Values assumed anomalous